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Macroeconomic Adjustment and Growth

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Macroeconomic Structure and Policy in Zimbabwe

Analysis and Empirical Model (1965-88)

Ibrahim A. Elbadawi
and
Klaus Schmidt-Hebbel

A macroeconomic general equilibrium model for Zimbabwe.

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This paper — a product of the Macroeconomic Adjustment and Growth Division, Country Economics Department — is part of the division's development of RMSM-XX, an applied macroeconomic general equilibrium model for policy simulations and economic projections. Copies are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Susheela Jonnakuty, room N11-039, extension 39074 (79 pages). September 1991.

Elbadawi and Schmidt-Hebbel develop and apply a macroeconomic general equilibrium model for Zimbabwe.

Zimbabwe faces the challenge of engaging in a program of fiscal stabilization and structural reform to address its current fiscal imbalance, high unemployment, and low growth prospects. Elbadawi and Schmidt-Hebbel discuss macroeconomic changes over the last two decades, provide a model of the macroeconomic structure, and estimate aggregate equations for the main goods and asset markets.

The macroeconomic framework they model integrates three features of the country's macroeconomy:

- The noninflationary and almost exclusively domestic financing of the public sector deficit, which has been similar in gross terms to the private sector surplus.
- Sustained negative or low real interest rates, together with no apparent sign of excess demand in credit markets.
- Most important — after the dramatic economic declines of the late 1970s that resulted from economic sanctions and civil war — the fact that sustained, high growth has never materialized.

The framework presented in this paper is integrated into a general equilibrium macroeconomic model (a RMSM-XX model) in a companion paper, "Macroeconomic Adjustment to Oil Shocks and Fiscal Reform: Simulations for Zimbabwe, 1988-95 (WPS 772). In that paper it is used to analyze alternative fiscal and oil price scenarios for Zimbabwe.

CONTENTS

* This output is part of CECMG's development of RMSM-XX, an applied macroeconomic general equilibrium model for policy simulations and economic projections. The paper has benefitted from data and initial discussions provided generously by Imam Hassan and Anna Muganda (AF6CO) and Lloyd Mckay (Resident Mission, Harare). Additionally, the country desk provided helpful comments that have been received and taken into account. We also thank Vittorio Corbo, Carlos Elbirt, Roger Grawe, Miguel Kiguel, Lloyd Mckay, Luis Riveros, Luis Serven, Andres Solimano, Michael Walton, and participants at a World Bank seminar for their useful comments to an earlier version. Efficient research assistance by C. Almero, L. Bouton, J. Castillo, R. Chun, A. Kimemia and N. Majd is gratefully acknowledged.

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1. INTRODUCTION

The Zimbabwean economy presents a rather infrequent blend of a macroeconomic situation which seems to be stable at a first glance and a wide array of trade and factor market distortions which hamper investment and growth prospects. The following main features of the Zimbabwean economy are crucial to understanding the recent and prospective future evolution of macroeconomic development in the country: a high public sector deficit, a strict and detailed system of exchange control and import rationing with the brunt of the enforcement borne by private sector imports (including investment goods), and well developed, yet managed, financial markets.[1]

The current account is almost balanced, the real exchange rate is relatively stable, and inflation and real interest rates are relatively low (see tables 1.1-1.3). However, there is a sizable public sector deficit financed by foreign debt in the early eighties and by domestic debt since the mid-1980s. A partial fiscal adjustment took place after 1987, contributing to the stabilization of public liabilities to GDP ratios during the last two years. Domestic interest rates have been partially decontrolled, and therefore currently higher and still rising rates reflect the partial financial liberalization and, possibly, the increase in domestic debt.[2]

Three related stylized facts of the above macroeconomic scene need to be made explicit. First, the non-inflationary and almost exclusively domestic financing of the public sector deficit - which in gross terms has been similar to the private sector surplus; second, the sustained negative or low real interest rates - albeit slightly increasing - with no apparent sign of excess demand in credit markets; third, and most important, after the dramatic economic

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[1]Among recent papers on Zimbabwe's macroeconomic situation and prospects are Chibber et al. (1989), Dailami and Walton (1989), Davis and Rattso (1990), Khadr et al. (1989), McKay (1989), Morande and Schmidt-Hebbel (1991), and Schmidt-Hebbel (1990).

[2]The rising interest rates may also reflect the easing of import constraints, as foreign debt service payments have fallen since 1987, and a growing realization by savers of real as compared to nominal interest rates.

declines of the late 1970s as a result of economic sanctions and the civil war, sustained and deep economic recovery has never materialized with real GDP growing at a low annual average of only about 2.7% between 1982 and 1989, and including negative growth in 1984 and 1987 (mainly caused by droughts, however).

The interpretation of these stylized facts in light of the above cited salient features of the Zimbabwean economy goes like this: the centralized foreign exchange allocation mechanism effectively constrains private consumption and private investment, with respect to what would have resulted with less restricted access to foreign exchange. Zimbabweans are not able to substitute domestic goods for foreign goods to the extent that total private consumption and total private investment do not decline. The restriction on aggregate private consumption implies that effective private saving exceeds what we could term a "notional" saving level[3].

In addition to the restrictions imposed on it by the exchange and foreign trade regime, private investment is further reduced by significant uncertainties with respect to political and policy changes which could be reflected in changing property rights, taxes and relative prices. Similar to the case of private consumption, the restriction on private investment leads to an effective private investment less than a "notional" level. Both factors together explain the high net private sector surplus observed in the last four to five years. The combination of this 'institutional' crowding out of private investment while less public investment is being allocated to physical capital has substantially reduced the potential for higher growth and may have reduced the quality of investment, hence further muting its impact on growth. Furthermore, to the extent that imported intermediate and capital goods are not perfect substitutes to domestic goods, the import compression and exchange controls are likely to reduce capacity utilization even for the already low capacity growth noted for Zimbabwe (see Ndulu (1990) for evidence on this in Sub-Saharan Africa in general).

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[3]That is, the saving level that would result if the foreign exchange allocation mechanism were not binding for private consumption.

In the end, financial markets have played[4] the role of transferring the private sector surplus to the public sector such that the latter is able to cope with its deficit. This has been facilitated by several regulations in the financial markets that make such transfer somewhat compulsory, and by low real interest rates resulting from both the abundance of private saving and an adequate monetary policy management.

In assessing the economic achievements of independent Zimbabwe two are the most impressive: first, the restructuring of agriculture and its reorientation towards communal scale farmers through redirection of credit, extension, and marketing services, as well as maintenance of producers incentives; second, the considerable development of the country's human capital. This relatively credible economic performance has been achieved with minimal policy shifts and with the inherited system of economic controls kept intact.

It is now widely acknowledged both in Zimbabwe and in the international development community that economic reform is needed to achieve fiscal and macroeconomic stability and to put the economy on a sustainable path of higher growth. The broad elements of this reform should include the f llowing (see for example Morande and Schmidt-Hebbel (1991)). First, a continued and deeper fiscal adjustment to further reduce the consolidated public sector deficit to more sustainable levels[5] and to allow a recovery of private expenditure. Second, product, factor and financial market deregulation including further deepening of the current financial liberalization. Third, a phased trade liberalization program replacing the current foreign exchange allocation regime with a market based system in order to reduce the high trade distortions and to increase competitiveness and growth prospects of the economy.

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[4]Financial markets and institutions in Zimbabwe are well developed. The financial institutions include the Reserve Bank of Zimbabwe, five commercial banks, four merchant banks, two discount houses, three building societies, the Post Office Savings Bank, and a large number of insurance companies and pension funds. There is a stock exchange as well as several development finance institutions.

[5]For an analysis of the sustainability of Zimbabwe's present public sector deficit see Schmidt-Hebbel (1990).

Already there are some signs that the authorities are moving towards this direction with the government unveiling a plan for reducing the fiscal deficit to 5% of GDP by 1994/95. An equally important announcement was the pledge by the authorities to achieve this through cutting down on parastatal losses and on expenditure rather than attempting to raise revenue, implying that such fiscal adjustment is more likely to translate into higher private sector expenditure. Concerned by the low investment levels and the ensuing constraints on growth, the government also effected direct incentive plans for private investment and business confidence restoration.[6]

This paper presents a macroeconomic framework which will be used to analyze the economy of Zimbabwe with special emphasis on modelling the above stylized facts and drawing the potential implications for the Zimbabwean economy. The estimations obtained in this paper are subsequently used as an input to a companion paper which presents a complete macroeconomic general equilibrium model used for 1988-1995 simulations of alternative external environment and domestic policy scenarios in Zimbabwe, as part of the CECMG division's development of RMSM-XX models and the collaborative work with the AF6CO division. In the remainder of this section we will further review macroeconomic development in Zimbabwe and provide comparisons between the pre and post-independence periods. Section 2 presents the behavioral model structure, comprised by a two-sector goods market block and a portfolio structure for asset markets. Section 3 analyzes model closure under a positive mode, identifying the interactions of the main endogenous variables illustrated by simple comparative statics exercises. Section 4 discusses estimations issues and results. Section 5 concludes.

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[6]This included reduction and streamlining of administrative controls through one authority (the newly created Zimbabwe Investment Center). In addition, the authorities hoped to promote foreign direct investment through greater flexibility in external remittances and the signing of international investment guarantees.

1.1 An Overview of Macroeconomic Development in Zimbabwe

1.1.1 A Long Term Episodical Comparison

Taking a longer term view of macroeconomic development in Zimbabwe, three distinct episodes can be distinguished over the 1965-88 period: two pre-independence sub-periods (1965-72 and 1973-79), and to the current post-independence period covering 1980-1988. Representative period-average indicators are provided for these three sub-periods in Table 1.3, while Tables 1.1 and 1.2, respectively, provide more details for the post and pre- independence periods.

The first period was one of high growth with real GDP rising at an annual average of 6.7%, the second - dominated by the war of independence and economic sanctions - was a lost era in terms of economic growth. Then the economy rebounded significantly in the first two years of independent Zimbabwe, but for the remainder of the post-independence period the recovery is not complete with an annual average growth of about 2.7 %.

The evolution of real economic growth in Zimbabwe is closely linked to the dramatic shift in the shares of public and private sector expenditure in GDP. Private consumption declined from 68.3% in 1965-1972 to 61.4% in 1980-88 (and declined further to 50.9% in 1989), while public consumption almost doubled from 11.6% to 20.8%. Private fixed investment, which averaged 9.1% and 11.5% for the first and second periods, declined to 9.5% after independence. Public fixed investment on the other hand did not match the decline in private investment, with an increase of only 0.4 percentage points of GDP relative to the previous average of 7.5%. As mentioned above, the preoccupation of independent Zimbabwe has been to redress accumulated historical inequalities and to improve the stock of human capital for the majority of the population by investing in education, health and other social sectors. While this type of investment is obviously quite justified from the view point of both political and long term economic performance, the parallel reduction in fixed investment was the main cause of the only modest economic growth achieved over the recent period. The squeeze on private sector expenditure is mainly achieved by an elaborate and clearly effective system of exchange controls and import rationing, the manifestation of

it clearly reflected in the significant drop in the import share in GDP, which declined from 31.6% in the first period to 28.2% in the last.[7]

Inflation and nominal interest rates (especially the one on public debt), even though they have risen steadily over the three episodes, are still low and the macroeconomy continues to be stable. Inflation, however, has varied inversely with the GDP growth rate, an indication that supply factors may have been dominant. The potential inflationary effects of supply constraints or import restrictions have so far been effectively contained through a system of direct price controls, including a price freeze in 1987-89. Real wages have risen considerably, whose counterpart has been the achievement of only a modest real depreciation over the three periods. Between the 1965-72 and 1980-88 periods, wages have risen by more than 32% in real terms while the real exchange rate depreciated by about 18%, and unemployment stands now at a high rate of 26%. It is not surprising, it seems therefore, that export growth which averaged more than 3% per annum over the last decade would not keep pace with the overall growth in the economy (averaging more than 4% for the same period), and hence, the previous export to GDP ratios set in the first period could not be reestablished

1.1.2 The Macroeconomy in the 1980s

Focusing on the country's post-independence decade of the 1980s, we present in table 1 data on broad macro and sectoral indicators for Zimbabwe over the period in question. As we mentioned earlier, growth over this period has been hesitant and has reflected only a partial recovery from the dramatic depression of the period before independence. The main reason seems to be the depressed level of fixed investment, which is also reflected in the relatively low excess capacity of the economy.

The real interest rate on public debt has been negative for most of the time implying a subsidy to the public sector, though the nominal rate on public debt

[7]This drop, however, may be accounted for by a greater exchange rate distortion in the latter period.

has been gradually increasing to match the higher nominal interest rate on deposits. Over the last three years macroeconomic stability is further strengthened by sustained real depreciation - compared to the previous year, the real exchange rate has depreciated by 9.6%, 14.5%, and 8.3% in 1987, 1988, and 1989, respectively. Furthermore, this development is consistent with the recent trade liberalization and worsening of Zimbabwe's terms of trade.

The public sector deficit has risen considerably to average more than 12% of GDP over the last decade. Despite the huge deficit no impending external debt crisis is developing. In fact the government's external debt policy has been very prudent and the debt to GDP ratio, which reached 42.2% in 1985, declined to about 38% in 1988-89 (see table 1.1). Instead the government has relied to a more significant extent on domestic financing of its deficit, pushing up its domestic debt to GDP ratio from 31.3% in 1983 to 43% in 1988.

Between 1982 and 1987 the current account deficit was reduced from US$762 m. to US$3 m., which amounts to a 10 percentage point of GDP reduction. This massive improvement in external accounts relied exclusively on the private sector, while up to 1986/87 the non-financial public sector deficit hovered around 14% of GDP. In fact, during the latter fiscal year, when the public deficit reached again its previous record 14.4%, 100% of that deficit was financed by the private sector. As discussed above, a partial public sector adjustment took place starting in 1987/88, implying a reduction of 3.5 percentage points in the deficit and an additional 0.5 percentage point decline in 1988/89. The private sector benefitted directly from this decline, with a similar reduction in its required surplus.

To generate a surplus which finances 100% or more of the public deficit since 1986/87, the private sector raised significantly its saving rate: since 1984/85 it exceeds 20% of GDP and finances more than 100% of the economy's gross domestic investment. This private saving rate is very high for a developing economy -- a counterpart of very low private consumption rates, barely exceeding 50% of GDP during the last 5 years. High private saving channeled through Zimbabwe's developed financial system to the public sector is probably a result

of restrictions on private consumption (particularly imported consumer durables) and on formal or illegal capital outflows, coupled to a perception by the private sector that the domestic financial system is stable. However, some of these conditions might change, particularly those related to direct consumption repression as a consequence of trade reform.

Aggregate or domestic gross investment has not shown a strong downward trend during the 1980s. However, in 1986/87, when the public deficit reached again its record high, the domestic investment rate was about 3 percentage points lower than in 1980/81 when the high deficits started. And conversely, when fiscal adjustment took place after 1986/87, the domestic investment rate recovered by 2.4 percentage points. On the other side, the composition of investment changed significantly with the fiscal expansion of the early 1980s; in fact, the deficit increased approximately one by one with the increase of public investment, while private investment fell. With fiscal adjustment after 1986/87, both the absolute level and the share of private investment in domestic capital formation recovered, with a more than 3 percentage points rise in the private investment rate, while public investment did not suffer significantly.

The fact that both total investment and the share of private investment recover under fiscal adjustment is a significant step in the right direction, as growth -- which has been rather modest throughout the 1980s -- is strongly dependent on the quantity and quality of investment, the latter probably positively influenced by higher private investment shares. Hence additional investment gains, particularly in the private sector, could be positively influenced by continued fiscal adjustment. Fiscal adjustment should rely on additional gains in public saving, over and above the increase of the public saving rate from -3.9% in 1986/87 to -0.3% in 1988/89. Furthermore, trade liberalization and reduced import restrictions will have its own positive effects on growth by expanding the economy's capacity utilization and raising its efficiency level.

TABLE 1.1

ZIMBABWE MACROECONOMIC INDICATORS: 1980–89
(After Independence)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
A. Aggregate Indicators										
GDP growth (%)	10.6	12.5	2.6	1.6	-1.9	6.8	2.6	-1.5	6.5	4.9
Capacity Utilization	79.7	89.3	88.3	85.4	80.5	84.3	85.8	83.8	88.8	..
Inflation	10.3	14.5	14.2	19.4	3.5	2.6	15.2	9.2	11.9	12.9
Real Wage (1980=100)	100.0	103.7	114.5	110.2	111.5	120.7	112.3	110.1	110.1	107.2
Real Exchange Rate (1980=100)	100.0	115.1	132.0	134.2	123.3	108.7	119.7	108.2	92.5	85.6
Nominal Int. Rate on Public Debt (%)	4.4	5.9	7.8	7.7	8.0	10.4	12.3	13.0	13.3	13.0
Nominal Int. Rate on Deposits (%)	3.5	7.8	8.0	8.0	8.0	8.1	8.0	8.2	8.3	8.3
B. Composition of Output (% of GDP)										
Resource Balance	-3.0	-7.3	-5.9	-3.2	0.6	1.2	4.4	4.1	3.7	3.9
Exports	30.3	25.2	22.0	21.3	26.7	29.9	30.9	31.2	31.2	33.7
Imports	33.3	32.5	27.9	24.5	26.1	28.7	26.5	27.1	27.5	29.8
Total Consumption	84.2	84.2	84.6	84.5	83.7	85.4	81.9	76.8	74.7	73.9
Private Consumption	64.5	67.0	65.0	66.1	62.4	63.2	60.1	52.7	51.7	50.9
Public Consumption	19.7	17.2	19.8	18.4	21.3	22.2	21.8	24.1	23.0	23.0
Gross Fixed Capital Investment	15.3	18.6	19.9	19.6	18.5	16.1	15.8	15.5	17.9	18.6
Private Fixed Investment	10.6	13.3	10.0	8.2	10.6	7.9	8.4	7.8	9.0	9.4
Public Fixed Invcatment	4.7	5.3	9.9	11.4	7.9	8.2	7.4	7.7	8.9	9.2
Change in Stocks	3.5	4.4	1.2	-3.7	0.4	4.9	3.6	3.6	3.6	3.6
C. Consolidated NFPS (% of GDP)										
C.1 Fiscal Year Data										
Consolidated NFPS Deficit	9.1	13.5	13.1	14.4	12.7	14.3	14.4	10.9	10.4	..
Consolidated NFPS Foreign Debt	12.0	17.6	23.3	27.0	33.3	42.2	40.6	41.1	38.0	..
Consolidated NFPS Domestic Debt	43.4	37.2	33.7	31.3	35.7	35.5	36.6	41.7	42.9	..
C.2 Calendar Year Data										
Consolidated NFPS Deficit									8.8	9.7
Consolidated NFPS Foreign Debt									36.9	37.8
Consolidated NFPS Domestic Debt									47.4	46.9
D. Monetary Aggregates (% of GDP)										
Base Money	6.9	7.1	7.3	6.2	6.7	7.5	7.2	7.0	7.7	7.7
M1	18.4	15.3	15.9	11.9	13.5	14.3	13.3	13.7	15.1	15.1
Quasi Money	16.8	16.3	17.7	14.9	15.2	16.4	13.7	18.1	17.5	17.5
E. Balance of Payments (US$ mill.)										
Current Account	-301.0	-739.0	-762.0	-527.0	-177.0	-166.0	-51.0	-3.0	-3.0	..
Capital Account	176.0	419.0	668.0	203.0	285.0	225.0	159.0	149.0	91.0	..
Errors and Ommissions	56.0	94.0	-43.0	5.0	28.0	40.0	-44.0	-6.0	14.0	..
Position above the line	-69.0	-226.0	-136.0	-319.0	136.0	99.0	64.0	140.0	102.0	..
Stock of Gross Reserves	326	269	224	187	156	208	217	264	224	..

Note: Int. is Interest. NFPS is Non-Financial Public Sector.

Sources: Reserve Bank of Zimbabwe, Ministry of Finance of Zimbabwe, Schmidt-Hebbel (1990), and World Bank Data.

TABLE 1.2

ZIMBABWE MACROECONOMIC INDICATORS: 1965–79
(Before Independence)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
A. Aggregate Indicators															
GDP growth (%)	..	1.5	8.4	2.0	12.1	5.2	8.9	8.5	2.9	2.5	0.9	-0.8	-6.2	-2.2	3.8
Capacity Utilization	..	93.2	97.4	94.6	100.0	99.8	101.4	101.6	97.7	92.3	85.2	78.8	71.1	68.6	71.7
Inflation	..	..	0.6	3.8	5.1	2.6	5.7	5.3	8.3	17.0	6.4	9.3	8.2	9.7	15.2
Real Wage (1980=100)	75.7	82.2	83.9	83.6	82.3	85.4	86.4	85.9	86.3	77.3	88.5	90.4	92.3	92.2	90.3
Real Exchange Rate (1980=100)	149.1	130.2	131.5	138.5	143.0	140.6	139.2	149.8	152.8	131.1	126.3	121.8	119.5	115.4	97.2
Nominal Int. Rate on Public Debt (%)	5.3	5.3	5.3	5.4	5.3	5.5	5.6	5.7	5.7	6.1	5.9	5.6	5.7	5.8	5.1
Nominal Int. Rate on Deposits (%)	3.6	3.6	3.6	3.5	3.5	3.6	3.6	3.6	3.6	3.8	3.8	3.7	3.7	3.6	3.5
B. Composition of Output (% of GDP)															
Resource Balance	7.4	2.1	-0.7	-4.2	2.5	1.0	-1.8	2.8	2.0	-0.5	-1.2	3.9	2.4	3.5	-0.2
Exports	50.2	34.2	31.2	28.7	29.5	30.1	28.7	29.3	29.8	31.0	29.5	28.5	27.7	28.8	28.3
Imports	42.8	32.0	31.9	32.9	27.0	29.1	30.4	26.5	27.8	31.5	30.7	24.6	25.4	25.1	28.5
Total Consumption	78.7	82.1	79.0	81.4	79.9	80.2	80.9	77.1	76.0	72.1	74.1	77.2	78.5	84.7	87.5
Private Consumption	67.4	70.2	67.1	69.6	68.1	68.5	69.3	66.1	64.4	60.2	61.3	62.5	61.2	65.5	68.5
Public Consumption	11.4	12.0	11.9	11.8	11.8	11.7	11.5	11.0	11.6	11.9	12.8	14.7	17.4	19.1	19.0
Gross Fixed Capital Investment	12.8	11.6	13.0	17.5	14.2	16.2	17.8	18.0	21.2	22.6	23.4	19.7	17.2	14.5	14.0
Private Fixed Investment	7.6	6.9	7.7	10.4	8.4	9.6	11.2	11.3	13.4	14.2	13.7	11.2	10.1	8.4	9.2
Public Fixed Investment	5.2	4.7	5.3	7.1	5.8	6.6	6.6	6.7	7.9	8.4	9.7	8.5	7.1	6.1	4.8
Change in Stocks	1.1	4.2	8.7	5.3	3.4	2.6	3.1	2.0	0.8	5.9	3.6	-0.8	1.9	-2.6	-1.3
C. Consolidated NFPS (% of GDP)															
Consolidated NFPS Deficit	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Consolidated NFPS Foreign Debt	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Consolidated NFPS Domestic Debt	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
D. Monetary Aggregates (% of GDP)															
Base Money	..	..	..	..	..	..	..	..	..	..	5.5	5.8	6.4	6.4	5.9
M1	17.0	18.7	18.5	17.4	17.2	17.8	17.2	17.7	17.9	17.5	16.2	16.2	17.0	17.6	16.4
Quasi Money	7.4	9.8	11.2	10.9	10.6	11.6	12.0	11.4	12.1	12.1	12.9	15.3	16.1	17.4	16.7
E. Balance of Payments (US$ mill.)															
Current Account	..	..	..	..	..	-13.9	-59.0	-3.0	-21.6	-97.4	-22.1	-10.9	-14.0	37.2	-108.7
Capital Account	..	..	..	..	..	..	..	..	..	..	..	..	-21.3	64.4	108.0
Errors and Ommissions	..	..	..	..	..	..	0.5	-0.1	7.5	0.9	-3.5	-0.6	20.5	-26.6	119.4
Position above the line	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Stock of Gross Reserves	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Note and sources: see table 1.1.

TABLE 1.3

SUMMARY OF ZIMBABWE MACROECONOMIC INDICATORS
1965–72, 1973–79, AND 1980–88

	1965–1972	1973–1979	1980–1988
A. Aggregate Indicators			
GDP growth (%)	6.7 \1	0.1	4.4
Capacity Utilization	98.3 \1	80.8	85.1
Inflation	3.8 \2	10.3	11.2
Real Wage (1980=100)	83.2	88.2	110.3
Real Exchange Rate (1980=100)	140.2	123.4	114.9
Nominal Int. Rate on Public Debt (%)	5.4	5.7	9.2
Nominal Int. Rate on Deposits (%)	3.6	3.7	7.5
B. Composition of Output (% of GDP) (Fiscal Year Data)			
Resource Balance	1.2	1.4	-0.6
Exports	32.7	29.1	27.6
Imports	31.6	27.7	28.2
Total Consumption	79.9	78.6	82.2
Private Consumption	68.3	63.4	61.4
Public Consumption	11.6	15.2	20.8
Gross Fixed Capital Investment	15.1	19.0	17.5
Private Fixed Investment	9.1	11.5	9.5
Public Fixed Investment	6.0	7.5	7.9
Change in Stocks	3.8	1.0	2.4
C. Consolidated NFPS (% of GDP)			
Consolidated NFPS Deficit (FYt/t+1)	..	..	12.5
Consolidated NFPS Foreign Debt	..	..	30.6
Consolidated NFPS Domestic Debt	..	..	37.6
D. Monetary System (% of GDP)			
Base Money	..	6.0 \3	7.1
M1	17.7	17.0	14.6
Quasi Money	10.6	14.6	16.3
E. Balance of Payments (US$ mill.)			
Current Account	..	-33.9	-303.2
Capital Account	..	..	263.9
Errors and Ommissions	..	16.8	16.0
Position above the line	..	..	-23.2
Stock of Gross Reserves	..	..	230.6

\1 1966–72
\2 1967–72
\3 1975–79
Note and Sources: see table 1.1.

2. MODEL STRUCTURE

The behavioral model developed for Zimbabwe in this section presents the structure of goods and financial markets. It excludes the relevant budget constraints which are integrated with the behavioral model into a complete general equilibrium model in our companion paper.

The behavioral model for the Zimbabwean economy developed here assumes market clearing in both goods and asset markets. It is an extended IS-LM-aggregate supply model which allows for unemployment caused by rigid wages. On the supply side of the goods markets, potential output is linked to the economy's capital stock, and the deviation of actual from potential output supply is related to relative input prices. On the demand side, a two-dimensional disaggregation along the private-public sector and national-imported goods categories is adopted for investment and consumption. While the investment and consumption demands by the public sector were taken to be exogenous, behavioral specifications are adopted for the private expenditure demands. In addition to the two public and two private expenditure components, the domestic demand for intermediate imports and the foreign demand for exports are included on the demand side. For a policy-determined nominal exchange rate, the national-imported goods distinction permits the joint determination of the domestic price level (and hence of the real exchange rate) and real GDP by the model.

The asset markets, on the other hand, are a consolidated version of the complete asset specification embedded in the budget constraints developed in our companion paper, in order to distinguish the consolidated financial/non-financial private sector from its public sector counterpart.[8] A simple portfolio relationship for private sector holdings of base money and public debt determines the domestic interest rate of public sector debt. A traditional money supply equation relates base money to M2, whose composition between M1 and quasi money determines the interest rate on deposits.

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[8]The flow-of-funds sector disaggregation for Zimbabwe in our companion paper distinguishes between budgetary government, other public sector, central bank, commercial banking sector, non-financial private sector, and external sector.

A detailed discussion of the goods and asset markets follows.

2.1 Goods Markets

Goods market equilibrium is reflected by the basic macroeconomic equilibrium condition which relates output to aggregate demand:

$$(2.1.1) \quad y = c_p + c_b + fi_p + fi_b + fi_o + chst + \exp - imp$$

where y is GDP, c_p is private consumption, c_b is public budgetary consumption, fi_p is private fixed investment; fi_b and fi_o are, respectively, budgetary and extra-budgetary public fixed investment, chst is change in stocks, and exp and imp are exports and imports, respectively. All are constant-price variables.

The goods market equilibrium condition is an implicit equation in the price of national goods relative to the wage rate and the price of foreign goods, reflecting continuous market clearing in the market of national goods. In fact, equation (2.1.1) can be explicitly written as the equilibrium condition for national goods supply (GDP at the left hand side) and the sum of national goods demand components net of intermediate imports:

$$\begin{aligned} y = {} & dom_{cp} + imp_{cp} + dom_{cb} + imp_{cb} + dom_{ip} + imp_{ip} \\ & + dom_{ib} + imp_{ib} + dom_{io} + imp_{io} + chst + \exp - \\ & - [imp_{cp} + imp_{cb} + imp_{ip} + imp_{ib} + imp_{io} + mint] \end{aligned} \qquad (2.1.1')$$

where each aggregate demand component in equation (2.1.1') has been decomposed into its national (or domestic) and imported parts, denoted by dom and imp, respectively.

Therefore, once the import components of private and public expenditure variables are explicitly specified, there is no more need to specify independent import equations, excepting the demand for intermediate imports; i.e., imported consumption and investment goods demands drop from the right-hand side of eq. (2.1.1'). The following subsection is devoted to the supply of national goods, focusing on the capital stock, potential and actual output supply, and the demand for intermediate imports. Subsequently, the private sector demands for aggregate consumption and investment, their national/imported composition, and the foreign demand for Zimbabwean exports are introduced.

2.1.1 Capital Stock, Potential Output, Aggregate Supply and Intermediate Imports

Capital Stock and Potential Output

In order to derive a "sensible" relation between potential output and the capital stock, inexistent time series for these aggregates have to be obtained, taking into consideration the major structural changes which have affected the Zimbabwean economy since the early seventies.

Starting with the capital stock, combine the following steady-state aggregate capital and output growth assumption:[9]

$$(2.1.2) \qquad \Delta K/K_{-1} = \Delta y/y$$

with the following capital accumulation function:

$$(2.1.3) \qquad \Delta K = fi - \delta K_{-1}$$

to obtain a capital/output ratio for a representative base year:

$$(2.1.4) \qquad \frac{K_{-1}}{y} = \frac{fi/y}{\frac{\Delta y}{y} + \delta}$$

---

[9]Strictly speaking, equation (2.1.2) is a long-run equilibrium condition that can only approximately hold in the short run.

where K is the constant-price aggregate domestic capital stock, fi is aggregate gross fixed investment, and δ is the capital depreciation rate.

To derive the capital-output ratio from (2.1.4) for a representative, "normal" year, medium-term (1985-1988) average gross investment and GDP growth rates were combined with three alternative depreciation rates, yielding the following K/y ratios:

	$\delta_1 = 0.035$	$\delta_2 = 0.045$	$\delta_3 = 0.055$
I/y = 0.1795			
	2.6141	2.2818	2.0244
$\Delta y/y = 0.0337$			

1985, both a "normal" and recent year, was chosen as the base year for deriving the capital series making use of equation (2.1.3). Combining it with the intermediate depreciation rate $\delta_2 = 0.045$, the corresponding output/capital evolution during 1966-1988 is depicted in figure 1.

Three distinct periods characterize the output/capital and growth paths of Zimbabwe during the last 25 years. The first one, culminating in 1972, is characterized by high growth and stable y/K ratios. The 1973-1979 pre-independence period of oil shocks and growing internal conflict shows a protracted recession and imploding output/capital ratios. Finally, a partial, hesitant recovery starts in 1980 up to the present.

A major problem is how to interpret the 1981-1988 y/K ratio. Does it reflect lower efficiency in the use of capital (as compared to the 1960s) or lower capacity utilization, or both?

In the absence of reliable data on capacity utilization and labor unemployment, we opted for assuming that it is due to both reasons. This implies that the potential output/capital ratio during the 1980s is a weighted average of the actual output/capital ratio of the 1960s and the 1980s. We assumed arbitrary weights of 0.5, which allow to draw the potential output/capital (yp/K)

ratio in figure 1.[10]. Hence, starting in 1981, and continuing into the future, we postulate the following relation between potential output and capital:

$$(2.1.5) \qquad yp = 0.5174\ K_{-1}$$

The corresponding actual and potential output series and their ratio are depicted in figures 2 and 3.

Output Supply

The deviation between actual and potential output is specified as the following logarithmic function of relative prices and supply disruptions (shocks) mostly related to Zimbabwe's conflictive pre-independence period:

$$(2.1.6) \qquad \ln\left(\frac{Y}{YP}\right) = \gamma + \lambda\left[\alpha \ln \frac{P}{We^{-\rho t}} + (1-\alpha)\ln \frac{P}{P_{Impint}}\right] + \beta\,(r_p - 0.045) + \Sigma_s \delta_s D_s$$

where P is the GDP deflator, W is the nominal unit wage, P_{Impint} is the price of intermediate imports, t is time, D_s are supply-specific dummies, and r_p is the real interest rate relevant for production decisions, defined as

$$(2.1.7) \qquad r_p = \frac{i_L - \hat{P}^e}{1 + \hat{P}^e}$$

where i_L is the nominal lending interest rate and $\hat{P}^e$ is expected inflation.

---

[10]In addition, it is assumed that actual output reaches its potential level in 1969 and that the 1972-1981 efficiency decline is reflected by a linearly decreasing potential output/capital ratio during that period.

Figure 1

Output/Capital and Potential Output/Capital Ratios: 1966-88

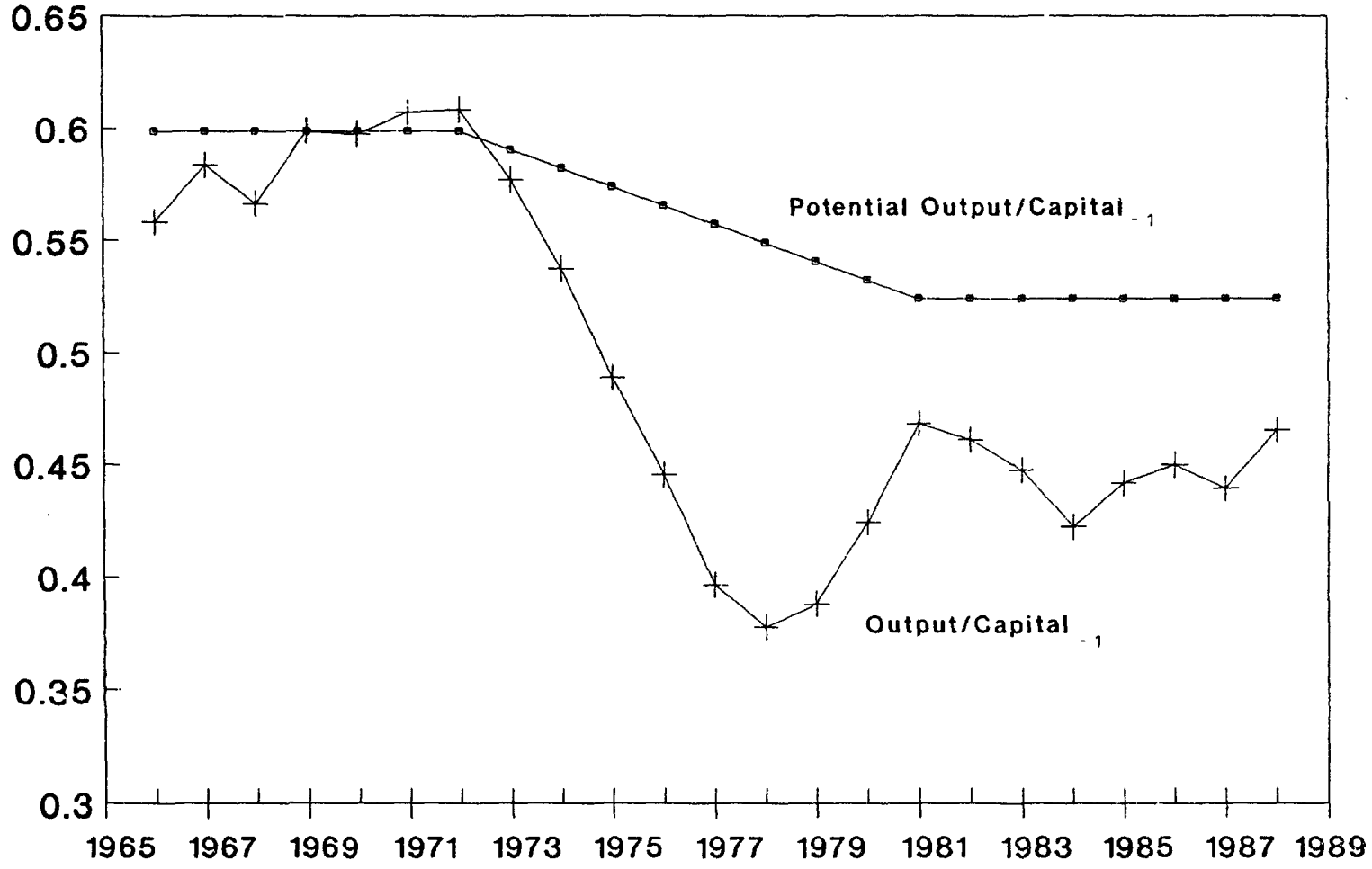


Figure 2

Potential and Actual Output Levels: 1966-88

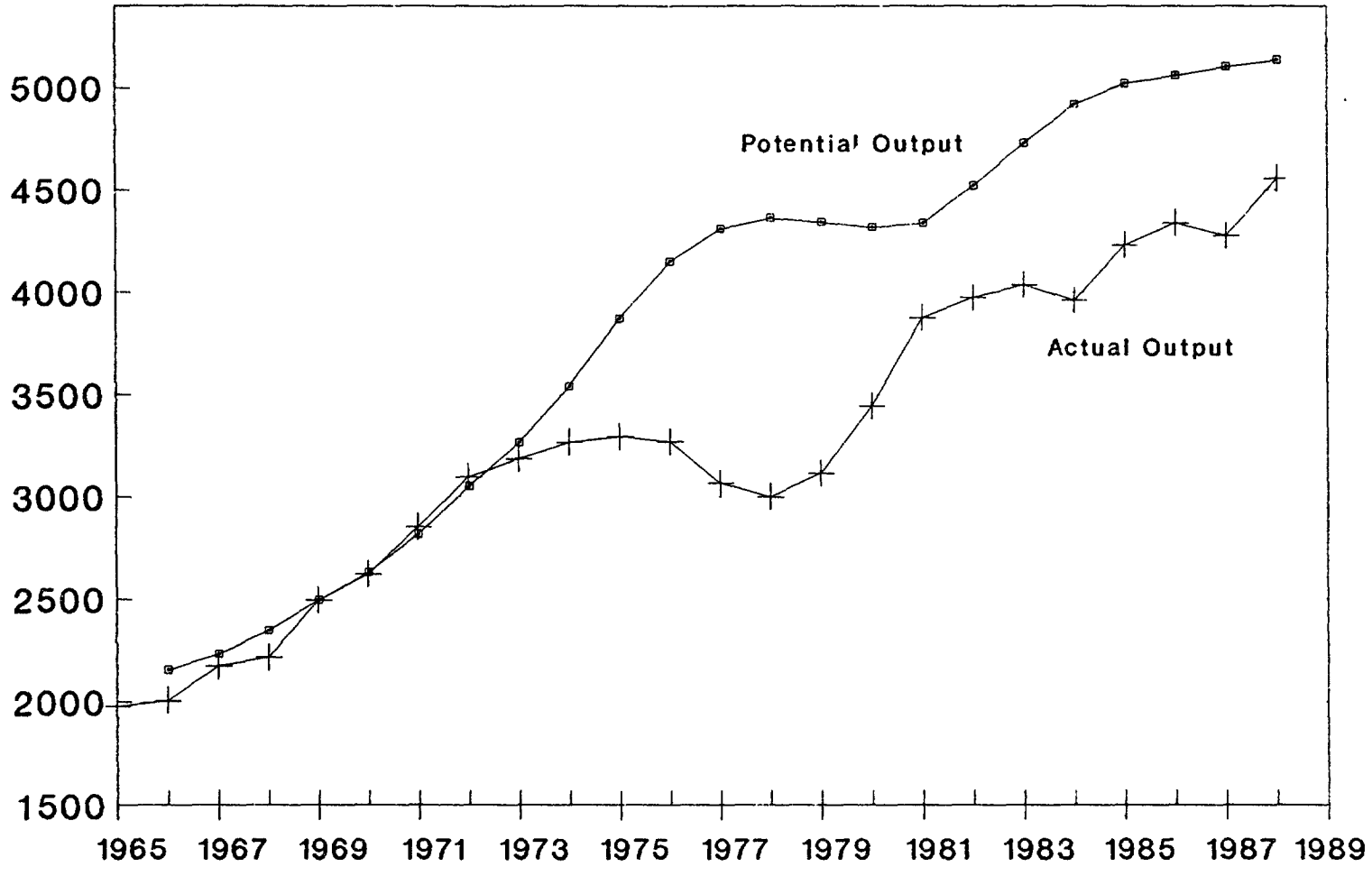


Figure 3

Actual/Potential Output Ratio: 1966-88

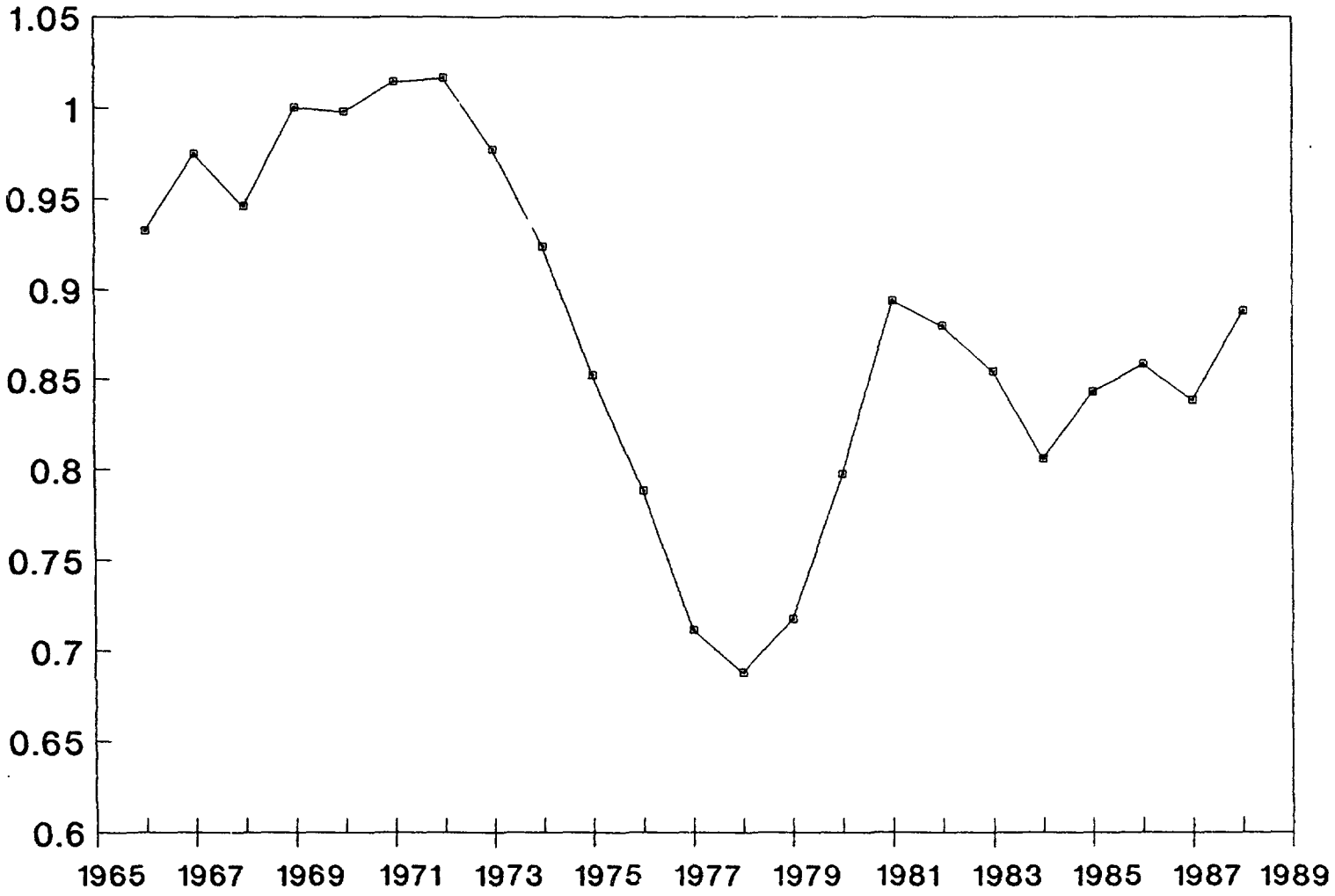
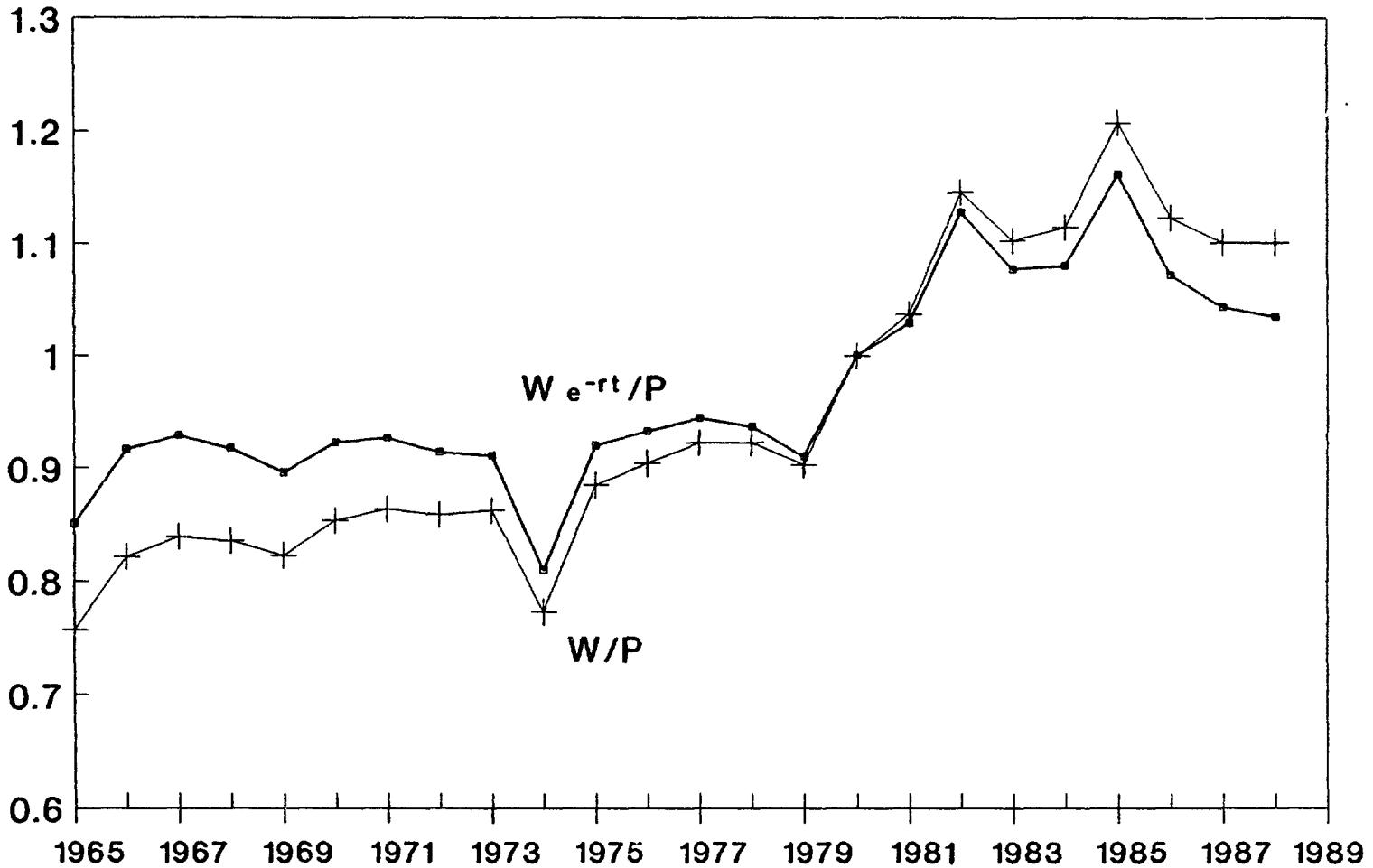


Figure 4

Unadjusted and Productivity-Adjusted Real Wage: 1965-88



Hence the real wage in (2.1.6) is adjusted for Harrod-neutral productivity increases at an annual rate of $\rho = 0.0076$. Equation (2.1.6) is a semi-reduced supply function, consistent with substituting variable input demands (for labor, intermediate imports and working capital) into a Cobb-Douglas production function with Harrod-neutral technical progress.

The latter rate is the 1965-1972 trend growth rate in real wages, assessed to be representative for a normal period of productivity-related wage increases when the economy was operating at levels close to full employment (see figure 3). From 1972 to 1979 real wages stagnated and after 1979 they grew strongly, probably reflecting both the partial output recovery and the political regime change. Figure 4 shows the evolution of actual and productivity-adjusted real wages during 1965-1988, taking 1980 as the base year.

A final feature of relative output supply equation (2.1.6) is that it is homogeneous of degree zero in absolute prices - a desirable property to avoid real effects stemming from changes in absolute prices.

Intermediate Imports

A separate equation is required for intermediate imports, which is the only component of total imports (and hence of aggregate demand) which reflects a production decision. Hence the demand for intermediate imports depends on the same variables as those determining output supply equation (2.1.6):

$$(2.1.8) \qquad \frac{mint}{yp} = \frac{mint}{yp}\left(\underset{(+)}{\frac{y}{yp}}, \underset{(?)}{\frac{P}{We^{-\rho t}}}, \underset{(+)}{\frac{P}{P_{Impint}}}, \underset{(?)}{r_p}\right)$$

where mint stands for intermediate imports.

2.1.2 Aggregate Demand Components

Next let's focus on the behavior of private expenditure aggregates and their composition as well as on the foreign demand for Zimbabwean exports.

Private Consumption

Aggregate private consumption is postulated to be a weighted average of consumption expenditure by liquidity-constrained and unconstrained intertemporal-optimizing consumers. Hence potential determinants of aggregate consumption demand may include variables signalling the influence of domestic liquidity constraints (disposable income, DY_p, and consumer credit, CC), foreign liquidity constraints (foreign saving FS) as well as variables reflecting intertemporal considerations such as permanent disposable income (PDY_p), permanent government saving (PS_g), and the real interest rate relevant for consumption decisions (r_c). Other variables which could affect private consumption are base money (SH), the consumption inflation rate (π_c), and the relative price of the imported and national components of aggregate private consumption (P_{Impcp}/P_{Domcp}).

Following Corbo and Schmidt-Hebbel (1991), we posit the following linear specification of the ratio of aggregate private consumption to private disposable income in equation (2.1.9) below. Our choice of this linear specification allows to discuss in an explicit manner certain economic propositions of interest to the analysis of consumption demand.

$$(2.1.9) \qquad \frac{C_p}{DY_p} = \beta_0 + \beta_1 \frac{PDY_p}{DY_p} + \beta_2 \frac{PS_g}{DY_p} + \beta_3 r_c + \beta_4 \pi + \beta_5 \frac{CC}{DY_p} + \beta_6 \frac{FS}{DY_p} + \beta_7 \frac{P_{Impcp}}{P_{Domcp}} + \beta_8 \frac{SH}{DY_p}$$

where all variables other than the real interest and inflation rates and the relative consumption price are defined in current prices, and hence C_p is current-price private consumption expenditure given by the product of constant-price consumption and its deflator $(C_p = c_p P_{cp})$. The real interest rate relevant for consumption, r_c, is defined as:

$$(2.1.10) \qquad r_c = \frac{i_B - \hat{\pi}^e_c}{1 + \hat{\pi}^e_c}$$

where i_g is the nominal interest rate on public debt and $\hat{P}_c^e$ is the expected rate of change in the consumption price deflator. Permanent private disposable income (PDY_p) and permanent public saving (PS_g) are the estimated permanent equivalents of current disposable income (DY_p) and current public saving (S_g) defined as:

$$(2.1.11) \qquad DY_p \equiv GDP - NFP_p + r_c B - T$$

$$(2.1.12) \qquad S_g \equiv T - C_g - NFP_g - r_c B$$

where NFP_p and NFP_g are, respectively, net foreign payments by the private and public sectors, T is tax revenue, C_g is government expenditure, and B is the net stock of public debt held by the private sector. While β_3, β_4, and β_7 in equation (2.1.9) cannot be signed a priori, all other coefficients are expected to be non-negative.

This specification (which is homogenous of degree zero in nominal variables) presents the convenient feature that, in addition to accounting for other consumption determinants, it nests the Keynesian (K), permanent income (PI) and Ricardian equivalence or direct crowing-out (RE/DC) hypotheses, which can be parameterized in terms of the model as:

K: $\beta_0 > 0$, $\beta_1 = 0 = \beta_2$

PI: $\beta_0 = 0 = \beta_2$, $\beta_1 > 0$

RE/DC: $\beta_0 = 0$, $\beta_1 = \beta_2 > 0$

Once aggregate private consumption is determined, the national (imported) component can then be determined as a function of aggregate consumption and relative prices. The imported (national) component can be recovered from the identity in (2.1.14).

$$(2.1.13) \quad dom_{cp} = dom_{cp}\,(P_{Impcp}\,/\,P_{Domcp},\ c_p)$$
$$\qquad\qquad\qquad\qquad\qquad\qquad\quad (+)\qquad\quad (+)$$

$$(2.1.14) \quad imp_{cp} = c_p - dom_{cp}$$

Private Investment

Aggregate private fixed investment is also specified to be responsive to both neoclassical determinants and liquidity constraints:

$$(2.1.15) \quad fi_p = fi_p\left(\frac{P_{ip}}{p}\,(i_L + \delta - \hat{P}_I),\ \frac{y}{K_{-1}},\ \frac{P_{Impip}}{P_{Domip}},\ \frac{FC}{P},\ \frac{PRO}{P},\ \frac{SH}{P}\right)$$
$$\qquad\qquad\qquad\qquad\qquad\quad (-)\qquad\quad (+)\qquad (?)\qquad (+)\qquad (+)\qquad (+)$$

The above specification is based on a static version of Tobin's q with $\frac{P_{ip}}{p}\,(i_L + \delta - \hat{P}_{ip})$ representing the real user cost of capital (where P_{ip} is the private fixed investment deflator), and $\frac{y}{K_{-1}}$, the average product of capital, is a proxy for the marginal productivity of capital.[11] The investment function also accounts for the effect of liquidity constraints through the presence of firm credit (FC), firm profits (PRO) and base money. The liquidity constraint can be interpreted to reflect the influence of credit allocation (including foreign exchange) on private investment. Finally the relative price of aggregate investment components $(\frac{P_{Impip}}{P_{Domip}})$, which essentially plays an allocative role, may or may not have a significant influence on aggregate investment.

The composition of private fixed investment is specified in analogous fashion to private consumption, as reflected by the two equations below.

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[11]The average productivity of capital is a linear function of the marginal product in the case of a Cobb-Douglas production function. In addition to the neoclassical hypothesis, the presence of this terms proxies the Keynesian accelerator hypothesis.

$$(2.1.16) \quad domip = dom_{ip}\ (P_{Impip}/P_{Domip},\ fi_p) \quad (+)\ (+)$$

$$(2.1.17) \quad imp_{ip} = fi_p - dom_{ip}$$

Foreign Demand for Exports

The foreign demand for exports is specified as depending on the export price relative to the price of substitutes $(\frac{P^*_{Exp}}{P^*_S})$ and the level of foreign demand given by real foreign GDP (y^*):[12]

$$(2.1.18) \quad \exp = \exp\ (P^*_{Exp}/P^*_S,\ y^*) \quad (-)\ (+)$$

Public Sector Demand

Equations (2.1.19) - (2.1.21) below give the disaggregation of the exogenous public sector demands for consumption and investment into their domestic and imported components.

(2.1.19) $c_b = dom_{cb} + imp_{cb}$

(2.1.20) $c_o = dom_{co} + imp_{co}$

(2.1.21) $fi_b = dom_{ib} + imp_{ib}$

(2.1.22) $fi_o = dom_{io} + imp_{io}$

2.2 Asset Markets

The specification of asset markets conforms to the sector disaggregation and portfolios identified by the RMSM-X structure.[13] However, it is useful to consolidate assets for achieving model simplification and to re-aggregate sectors

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[12]Even though the behavioral equation for exports in this model is given in terms of foreign demand, the model however, indirectly accounts for export capacity through the aggregate output supply channel.

[13]See Khadr et al. (1989).

for carrying out a more meaningful macroeconomic analysis. To do this, let's start by presenting in Table 2.1 the balance sheets of the basic RMSM-X's four sectors, consolidating assets and liabilities into major categories.

Total wealth of the private sector (W_p) is defined as the sum of financial wealth (WF_p) and real wealth, consistent with the balance sheet in Table 2:

$$(2.2.1) \quad W_p = WF_p + P_k K_p$$
$$= (SL_{pg} + SM1 + SQM - SL_{mp} - SL_{fp} - SDFI) + P_k K_p$$

Accumulation of financial and real wealth is consistent with the private sector saving and investment decisions, as shown by simple first-differencing of the preceding equation:[14]

$$(2.2.2) \quad dW_p = dWF_p + P_k dK$$

or:

$$(2.2.2) \quad S_p = d WF_p + P_k (fi_p - \delta K)$$

where private saving (S_p) is residually determined from consumption, and the latter, as well as investment, being determined in section 2.1 above.

Hence total wealth accumulation (or the total wealth stock in eq. 2.2.1) can be visualized as a two-stage portfolio allocation problem.[15] First the private sector decides between allocating its total wealth (its accumulation determined by saving) between the financial and real components, which is reflected by its investment decisions. Hence private financial wealth (WF_p) (or at least one of its components), is determined residually by equation (2.2.2).

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[14]To simplify the analysis, we are abstracting from capital valuation changes when differencing eq. (2.2.1), i.e. we assume $dP_K = 0$. The first-difference operator is denoted by d.

[15]This two-stage allocation is presented only for expositional clarity - both stages actually interact simultaneously.

The second state consists in allocating financial wealth among the different portfolio choices.

However, the financial wealth concept in (2.2.1) is not very useful for macroeconomic analysis because it reflects only the non-financial private sector wealth, excluding the financial private sector's portfolio decisions. Hence it does not reflect the influence of total domestic public debt on the private sector and on interest rates. A more meaningful sector disaggregation distinguishes between the consolidated financial and non-financial public sector (including the central bank) and the consolidated financial and non-financial private sector (including the commercial banking sector), the latter reflected by the corresponding balance sheet in Table 2.2.

Financial wealth of the consolidated financial/non-financial private sector (WF_{pp}), consistent with Table 2.2, is now:

$$(2.2.3) \quad WF_{pp} = SH + SB + (SNFA_{bs} - SDFI - SL_{fp})$$

Now let's derive a simple portfolio framework for this asset specification.

2.2.1 A Simple Portfolio Model

Zimbabwe has strict controls on capital outflows. Official capital outflows are forbidden, and unofficial outflows are repressed. According to most sources, there is no relevant parallel market. In addition, the country faces a foreign resource constraint. Hence foreign assets and liabilities in (2.2.3) can be taken as exogenous. Therefore the model collapses to a one-equation portfolio specification which determines the domestic nominal interest rate (i_B) on public debt:

$$(2.2.4) \quad \frac{SH}{SH+SB} = h\underset{(-)}{(i_B}, \underset{(?)}{y})$$

Note that real GDP enters the right hand side with an ambiguous sign, reflecting the fact that its influence on portfolio allocation depends on the difference between income elasticities of the underlying structural demands for SH and SB.

2.2.2 Money and the Financial Sector

In order to relate "ultimate" domestic private asset holdings (domestic debt and particularly base money), specified above, to monetary aggregates, let's make use of the traditional money supply equation:

$$(2.2.5) \qquad SMQM = \underset{(-)}{mult}\left(Res.Req., \frac{SCU}{M1}, \frac{SM1}{SMQM}\right) SH$$

where the multiplier (mult) is a function of reserve requirements and liquidity preference ratios.

The composition of MQM is determined by the private sector according to the nominal return on quasi-monetary assets (i_{QM}):

$$(2.2.6) \qquad \frac{SM1}{SM1 + SQM} = \underset{(-)}{m}(i_{QM})$$

Finally, let's obtain the interest rate on loans to the private sector (i_L) from the monetary system's zero-profit condition (which is assumed explicitly by RMSM-X's zero-current-account-surplus assumption for the monetary system):

$$(2.2.7) \qquad i_B\ (SL_{bsg} + SL_{cbg}) + i_L\ SL_{mp} + i^*\ SNFA = i_{QM}\ SMQM + Resid_m$$

where $Resid_m$ reflects any residual cash flows, corresponding to the monetary system's stock of net other liabilities (SNOL).

Hence equations (2.2.4), (2.2.6) and (2.2.7) determine the three main

nominal interest rates of the model. Two of them - i_s and i_L - play a role in determining the real interest rates relevant for output supply, consumption and investment decisions, as reflected by equations (2.1.6), (2.1.9) and (2.1.15) respectively.

2.2.3 Inflation Expectations

There are two basic forms for deriving operational expressions for the expected rate of change of any deflator D, defined as $\pi^e_{t,\,t+1} = (D^e_{t,\,t+1} - D_t)/D_t$. One is the rational expectations specification $D^e_{t,\,t+1} = E[P_{t+1}|I_t]$,involving the solution of the macroeconomic general equilibrium model for one (and hence $n \to \infty$) periods into the future along a multiple shooting model - really not advisable for an operational simulation model. The remaining alternative is to specify an ad-hoc, irrational and backward-looking specification, only advisable because of its easy implementation. We favor the latter based on expectations consistent with a time-series autoregressive representation of the general form:

$$(2.2.8) \qquad \pi_{t+1} = A(L)\,\pi_t$$

where A(L) is a finite polynomial in the lag operator.

TABLE 2.1

BALANCE SHEETS OF 4 SECTORS, CONSISTENT WITH RMSM-X DISAGGREGATION

Consolidated Non-Financial Public Sector

$P_k K_g$	SL_{pg}
	SL_{mg}
	SL_{fg}

Monetary System

SL_{mg}	SM1
SL_{mp}	SQM
SNFA	SNOL

Consolidated Non-Financial Private Sector

SL_{pg}	SL_{mp}
SM1	SL_{fp}
SQM	SDFI
$P_k K_p$	

Foreign Sector (Balance of Payments)

SL_{fg}	SNFA
SL_{fp}	
SDFI	

Notation

The letter S preceding any variable denotes a stock variable, L denotes loans outstanding and the letters g, m, p, and f (and cb, bs in table 2) denote the following sectors: consolidated non-financial public sector, consolidated monetary system, consolidated non-financial private sector, and foreign sector (and central bank and commercial banking system in table 2). The first lower-case letter denotes the creditor or holder and the second the debtor or issuer of the corresponding liability; for instance, SLpg denotes the outstanding loans from the non-financial private to the non-financial government sector.

Other variables are: SM1 is M1, SQM is quasi-money, SNOL is net other liabilities of the monetary system, SNFA is net foreign assets of the monetary system, and SDFI is direct foreign investment (holdings by foreign investors). Finally, SKg and SKp are real public and private capital stocks, respectively, and P_K is its price, which corresponds to the product of Tobin's q and an appropriate deflator.

TABLE 2.2

BALANCE SHEETS OF THE CENTRAL BANK, COMMERCIAL BANKING SYSTEM, NON-FINANCIAL PRIVATE SECTOR, AND CONSOLIDATED FINANCIAL/NON-FINANCIAL PRIVATE SECTOR

Central Bank

$SNFA_{cb}$	SRes
SL_{cbg}	SCU
SL_{cbm}	
L_{cbp}	

Commercial Banks

$SNFA_{bs}$	SQM
SRes	SM1-SCU
SL_{bsg}	SNOL
SL_{bsp}	

Non-Financial Private Sector

SL_{pg}	SL_{cbp}
SM1	L_{bsp}
SQM	Lfp
SNOL	DFI
$P_k K_p$	

Consolid.Fin/Non-F. Priv. Sector

$SNFA_{bs}$	SDFI
	SL_{fp}
$SH = SRes + SCU$	
$SB = SL_{bsg} + SL_{pg} - SL_{cbp}$	
$P_k K_p$	

Notation

SRes is banking sector reserves at the central bank, SCU is currency, SH is base money, and SB is consolidated total public sector domestic debt.

3. MODEL CLOSURE

This section analyzes the model closure for the positive mode, which involves an endogenous determination of relative prices, quantities and interest rates.

The two main equations are the goods and asset markets equilibrium conditions, conveniently summarized as follows:

$$(3.1) \qquad y^s\left(\underset{(+)}{\frac{P}{E\,P^*}}, \underset{(+)}{\frac{P}{W}}, \ldots\right) = y^d\left(\underset{(-)}{\frac{P}{E\,P^*}}, \underset{(+)}{\frac{SH}{P}}, \underset{(+)}{\frac{SH}{P}}, \underset{(-)}{r}, \ldots\right) \qquad \text{(GM)}$$

$$(3.2) \qquad \frac{SH}{SH + SB} = \underset{(-)}{h(i)} = h(\underset{(-)}{r+\pi^e}) \qquad \text{(AM)}$$

which for the sake of this discussion assumes away the differences between aggregate demand and supply deflators and between interest rates, which are considered in the model of section 2.

While the GM schedule determines jointly real output y and the GDP deflator P (and hence the real exchange rate for a nominal exchange rate fixed by the central bank), the AM schedule determines the nominal interest rate (and hence the real interest rate for given inflation expectations).

Figure 5 summarizes the interaction between goods markets equilibria (in quadrants I and II) and asset markets equilibria (in II and III). In addition, it shows the simple and static general equilibrium effects of:

(i) an increase in inflation expectations (from π^e_0 to π^e_1), holding SH constant, which reduces the real interest rate, increases output, and appreciates the real exchange rate (A to B); and

(ii) a rise in base money (from SH_0 to SH_1), which reduces the real interest rate, and has an even stronger effect on output and the real exchange rate (A to C).

An interesting result to note from these simple comparative-static exercises is that our blend of goods markets cum portfolio equilibrium allows to derive residually a traditional monetarist demand function for base money, with

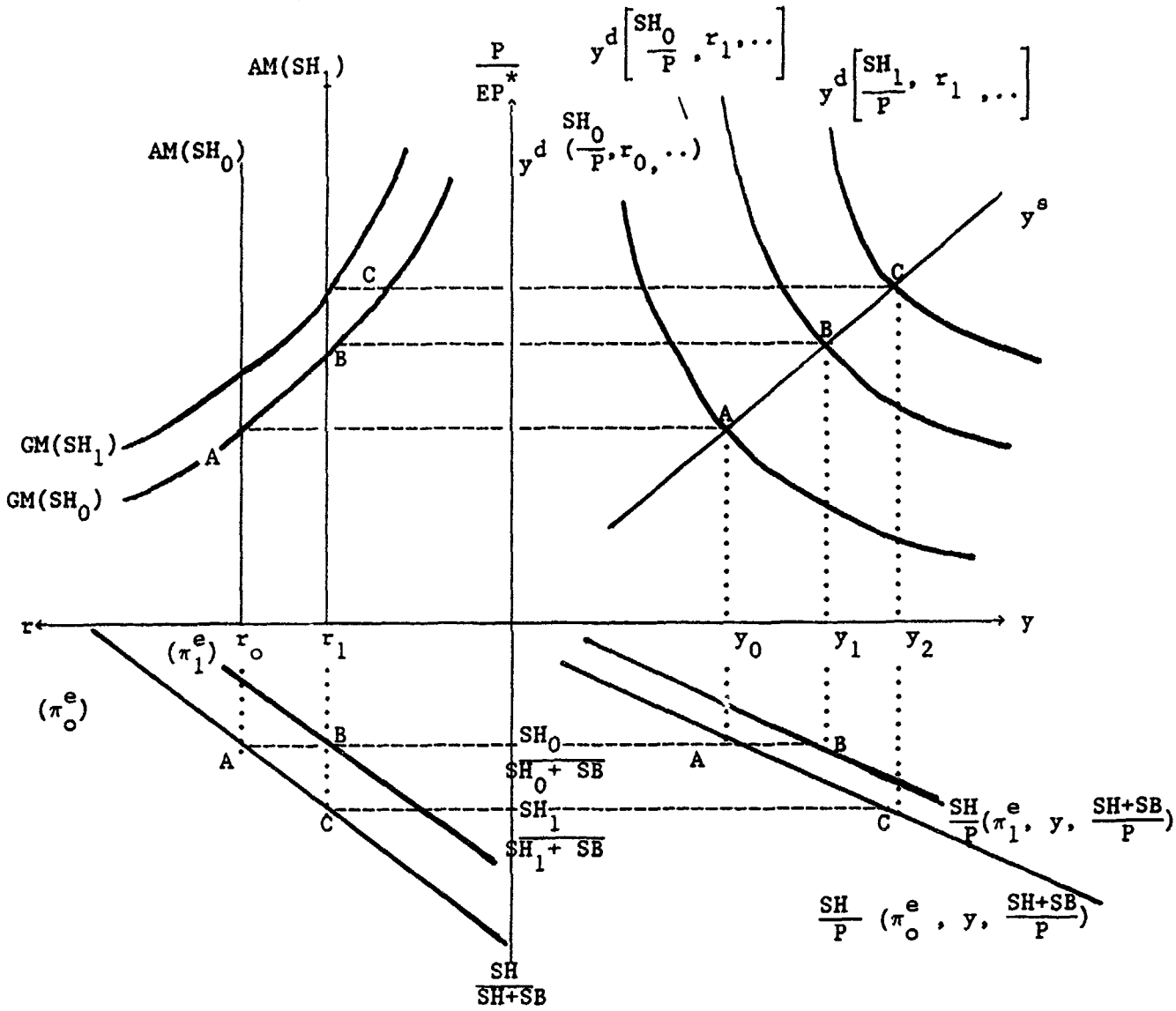
a unit financial-wealth elasticity:

$$(3.3) \qquad \frac{SH}{P} = hm\left(\underset{(-)}{\pi^e}, \underset{(+)}{y}\right)\frac{SH+SB}{P}$$

which is the one appearing in quadrant IV.

Figure 5

Macroeconomic General Equilibrium



Comparative Static Exercises:

(i) Increase in inflation expectations, holding SH constant: A → B

(ii) Increase in money supply, holding π^e constant: A → C.

4. ESTIMATION RESULTS

4.1 Empirical Specification Alternatives

The main challenge in the empirical estimation of behavioral functions for Zimbabwe is to obtain econometrically sensible results that bode well with the simulations (presented in our companion paper), while only a few degrees of freedom are available. Also due to the nonstationarity that characterizes most of economic time series data, it is critical to avoid the 'spurious regression problem' that plagues econometric estimation when some (or all) of the individual series are nonstationary (see Granger and Newbold (1974), and Nelson and Plosser (1982)). This motivated us to impose a normalization by estimating specifications on levels ratios with respect to scale variables of interest (such as GDP). This has the desirable property of improving the efficiency of estimation as well as reducing individual series nonstationarity and therefore minimizing the influence of spurious effects on the regression. As long as such normalization is not strongly rejected by the time series structure of the variables involved, it can improve the chances for estimating the true parameters of interest.

The theory of cointegration provides a formal framework for testing the hypothesis that a stable long-run relationship (or an economic equilibrium) exists (see Engle and Granger (1987)).[16] Loosely speaking, a vector of variables (which may be individually nonstationary) is said to be cointegrating if there exists a linear combination between the variables that is stationary. Cointegration is a long-run (static) specification theory, but it is also shown to be consistent with the error-correction dynamic specification (Engle and Granger, 1987). This can be particularly useful in unrestricted (non-normalized) equations which are consistent with long run equilibrium but may be characterized by considerable short run dynamics. This is because the error-correction models capture the time series properties of variables, through the more robust dynamic

[16]For other useful references and applications, see the two survey papers by Dolado and Jenkinson (1987) and Diebold and Nerlove (1988), in addition to Kaminsky (1988) and Perron (1988), to mention a few examples.

structure allowed, whilst at the same time incorporating an equilibrium economic theory.[17] Given the paucity of the data available for Zimbabwe, we will not pursue this second (unrestricted) error-correction approach in this paper. Instead we will confine ourselves to the scale-normalized specifications, for which cointegration will be indirectly tested using residual autocorrelations.

4.2 Econometric Estimation

4.2.1 Preliminary Estimation and Data Construction

As input to the major behavioral equations discussed in sections 2, we need to construct the data of expected inflation for the aggregate price level as well as for consumption and investment prices. This will require estimation of equation (2.2.8) above. Even though we intend to conduct careful analysis of price expectation in the future using the above approach, for the purpose of this exercise we interchangeably used both static expectations $(\pi^e_{t+1} = \pi_t)$ and perfect foresight $(\pi^e_{t+1} = \pi_{t+1})$.[18]

Finally we constructed the permanent private disposable income and permanent government saving series, required for the estimation of the consumption function, as a three-year moving average of their corresponding current series. A more rigorous approach based on decomposition of time series into permanent and transitory components, e.g. Nelson and Plosser (1982), Beveridge and Nelson (1981), and Cuddington and Urzua (1989) is available. This later approach, however, is certainly not advisable for the Zimbabwe model because of its data requirements. Also experience from previous studies suggests that moving averages are reasonable approximations.

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[17]Currently there is an explosion of papers applying the error-correction model. For a partial list see Hendry and von Ungern Sternberg (1980), Domowitz and Elbadawi (1987), Domowitz and Hakkio (1989), and references cited therein.

[18]The choice between static expectations and perfect foresight is indicated in the appendix for each relevant equation.

4.2.2 Estimation Results

Estimates of the equations of section 2 are contained in annex A. For the sake of comparison, we present alternative estimation results for most of the above behavioral equations. In Annex A each set of equations representing alternative estimation results for a given behavioral equation will be headed by the estimation results we judge to be the best amongst other alternatives. The discussion of the estimation results in the following sections will be mainly confined to this set of final equations. Also only this set of equations will be employed in the simulations of our companion paper. In the remainder of this section we first briefly and 'informally' discuss some diagnostic and validation issues. Then we provide an interpretation of the results and finally we end with a remark on the stability of our estimations.

4.2.2.a Diagnostic and Validation Issues

Except for the output supply equation which is in nonlinear logarithmic form, all the other equations reported in annex A below are in levels ratios (LR) specifications. Even though we did not attempt to conduct formal tests, it appears that the normalizations with respect to the scale variables (y, yp, PYD_p, H+B, I_p, C_p, and M2) in the various reported equations do not strongly violate the underlying data generating processes given the reasonably high explanatory power of the regressions. Tables A1.1 - A1.9 present statistics on autocorrelations for each of the variables that appear in the behavioral specification in addition to the autocorrelations of the corresponding residuals. The autocorrelations show that normalization is only partially successful in eliminating individual variables nonstationarity. More importantly, however, is that all the residuals are levels stationary and differencing seems to reduce their degrees of stationarity. This provides a semi-formal, yet strong, evidence that all of the normalized specification employed in this model are cointegrated, and hence they can be presumed to reflect (true) economic relationships.

In the cases of the nonlinear regression equations for output supply, the investment demand, the demand for intermediate imports, and the relative demand

for money, the models seem to be correctly specified and no evidence of residual serial correlation is present. For the rest of the equations, the correction for first order serial correlation in the residuals has generally been successful. This is an indication that the apparent residual serial correlations in these equations are not likely to have been caused by model mis-specifications. There are strong theoretical reasons to expect the behavioral specifications considered to be characterized by simultaneity problems. Except for the output supply and investment equations, however, no useful two-stage least square results could be obtained.

4.2.2.b Stability of Estimations

The last empirical exercise provides some evidence on the stability of the estimated relationships. We check stability using a metric based on out-of-sample forecasting performance. The equations of Annex A below are re-estimated for the period 1965-1986. This leaves two years for forecasts (except for aggregate consumption which is estimated up to 1987). Figures A.1 - A.9 show the observed series and their corresponding in-sample and out-of-sample forecasts. In general our in and out-of-sample forecasts seem to bode quite well with the observed behavior of the variables considered. Even though the estimated models display a common tendency to slightly overshoot peaks and undershoot troughs or vice versa, nonetheless all of them duplicated most of the observed peaks and troughs.

A formal test for model stability is based on two statistics. The first one is given by $\eta'\eta/S^2$, where η is the vector of post-sample residuals and S^2 is the within sample estimate of the error variance. This statistic is approximately distributed as X^2 (2), which is the length of the out of sample forecast period ($X^2(1)$ for aggregate consumption). The other test statistic is a simple Chow test which has an F-distribution.

Table A.2 provides the evidence on the above two statistics for all of the nine behavioral specification. The results provide strong support for the stability of the regressions. The null hypothesis could not be rejected at the

5% significance level using either of the two test statistics for all equations except for the asset demand specifications. While stability of the demand for base money relative to bonds is rejected by the X^2 text, the Chow F test, however, accepts the null hypothesis of stable relationship. In what follows (and not withstanding potential instability of the demand for money/quasi money specification), we assume that our reported estimating equations are 'statistically correct' and we now proceed to discuss the results.

4.2.2.c Interpretation of the Results

1. Intermediate Imports

According to equation (2.1.8), the demand for Mint expressed as a ratio to potential output is specified as a function of relative output supplies and relative prices. Estimates of the above specifications are provided in equation 1 of Annex A. In this equation all coefficient estimates are consistent with prior expectations. The coefficient of current relative to potential output is high at approximately 0.36 and highly significant with a 0.16% marginal significance level. The effects of the price ratios reflect the role of labor as a strong complement to Mint with a marginal effect on Mint/yp due to the real wage (adjusted for productivity gains) estimated at -0.16, which is slightly higher in absolute value than the own marginal effect due to the real price of imports (PMint/P), equal to -0.14. The real interest rate r_p reflecting the cost of financial capital was dropped from the equation since its effect is extremely insignificant. Finally the dummy variable D7075 accounts for an episode of sharply declining (relative to the average) Mint ratios witnessed during the 1970-75 period.

2. Output Supply

The aggregate supply function for the actual to potential output ratio was estimated according to equation (2.1.6). No evidence exists for the presence of a "Cavallo effect"; the non-significance of the real interest rate made us drop this variable from the following runs.

The price-elasticity of aggregate supply is rather modest --- 0.69 in the Non-Linear Two-Stage Least Squares (NLTSLS) equation. It implies that aggregate demand shocks (for a given aggregate demand elasticity) will have a stronger relative price than output effect.

The coefficient alpha (which is related to the share of labor in gross output) is very high and significant, reflecting the strong weight of the real product wage in comparison to the real exchange rate in determining short-run output. The low coefficient of the latter should not be surprising due to the elaborate ensemble of import rationing and foreign exchange control, which substantially undermined the allocational role of the real exchange rate.

Finally, Delta1 and Delta2 reflect the relative intensity of the supply disruptions during the 1974-1975-1976-1980-1984 and 1977-1978-1979 periods, which coincide mostly with the pre-independence period of foreign oil shocks and domestic civil war.

3. Aggregate Private Consumption

In the estimation of aggregate private consumption demand we distinguish between two specifications for the right-hand determinants comprised by inflation, the real interest rate, and the set of variables DY_p, SG, PDY_p, and PSG. Equation results 3.1 and 3.2 contain the estimates of the full model of equation (2.1.9) above using static expectations and partial perfect foresight values for the above mentioned variables, respectively. While both equations present good overall fits and do not show any evidence of mis-specification, virtually all of the right-hand side variables have no statistically significant effects on aggregate consumption and two liquidity constraints (consumer credit and base money) present opposite, although not significant, signs to those expected a priori. Less surprising is the low significance of the inflation and interest rates, with ambiguous a priori signs. As in most other developing countries (see for instance the cross-country studies by Giovannini (1983), Corbo and Schmidt-Hebbel (1991), and Schmidt-Hebbel, Webb and Corsetti (1991)), the well known substitution and wealth variables seem to be offsetting each other in

Zimbabwe.

To deal with the apparent over-parameterization and multicollinearity problems, we sequentially dropped some variables starting with the least significant ones; the new more parsimonious model concentrates on the Keynesian (current income), permanent income and Ricardian/direct crowding out (public saving) determinants. Two dummies are added to these two variables for the 1987-88 structural decline in private consumption and the 1984 outlier. The results of the restricted estimation are reported in equations 3 and 3.3.

The restricted model contains only $\frac{PDY_p}{DY_p}$ and $\frac{PS_G}{DY_p}$ as policy variables in the consumption demand specification. On accounts of the magnitude and significance of the coefficients as well the overall explanatory power, only the restricted static expectation model of equation 3 performed well. According to the latter, a $1 increase in expected permanent disposable income will lead to a $0.12 increase in aggregate consumption, at a 10.2% marginal significance level. This effect contrasts strongly with the much higher influence of current income (as measured by the constant), which raises private consumption by 61 cents for each dollar it increases. Also the effect of the expected permanent government surplus is positive and higher with a coefficient of 0.67 and a marginal significance level equal to 0.3%.

However, public saving affects strongly private consumption in Zimbabwe under the static expectation hypothesis while its effect is highly insignificant under the alternative expectation regime (partial perfect foresight). This is an indirect confirmation that it is direct crowding out of private saving by public saving and not Ricardian anticipation of future taxes which is behind the appreciable response of private consumption to public saving.

4. National-Good Private Consumption

As a ratio to aggregate private consumption, the demand for the national consumption good is substantially explained by the non-price autonomous demand reflected in the high (0.85) and extremely significant estimated intercept term. The price effect given by the coefficient of the relative price of the imported

to national consumption goods is as expected positive and highly significant, albeit with a low value at 0.05. As we mentioned in section 2 above, the corresponding estimates for the imported consumption goods ratio can be obtained from the adding up constraint.

5. Aggregate Private Fixed Investment

We estimated aggregate private fixed investment demand as a ratio of fixed investment to GDP according to equation (2.1.15) of section 2. Better results are obtained by estimating the equation with the user cost of capital $\frac{P_I}{P}(i_L + \delta - \hat{P}_I)$ split into its two components, $\frac{P_I}{P}$ and $(i_L + \delta - \hat{P}_I)$. This separation also allows us to examine the point made by Dailami and Walton (1989) in their analysis of investment demand in Zimbabwe, which holds the view that because neither foreign nor domestic firms borrow significantly from the domestic market, the domestic interest rate is only of weak significance. On the other hand, they argue that the relative price of the capital (investment) good is an important variable for all investors. While we agree with their assessment on the relative price $\frac{P_I}{P}$, we think that the real interest cost $(i_L + \delta - \hat{P}_I)$ has been marginal for investment decisions only during the 1970s and before the 1980's partial financial liberalization.

Initial runs based on specifications that include all of the determinants appearing in equation (2.1.15), generated estimates that are consistent with prior expectations; and except for the effects due to the interest cost (RIL) and the firm credit ratio (FCY), all other estimates are highly significant.

The only marginally significant effects obtained for FCY and RIL point to the possible existence of multicollinearity between these two variables, a matter that is entirely plausible from an economic perspective. Since evidence from Zimbabwe indicates that interest costs have been getting increasingly important as a determinant of private investment demand, and since the effect of liquidity constraints is reflected by the profit factor, we re-estimated the investment demand equation without the firm credit variable. The final equation obtained

from Two-State Least Squares (TSLS) estimation is reported in equation 5 of Annex A.

The effect due to the interest cost is estimated at -0.18, which is comparable to -0.123, the estimated coefficient of the relative cost of the capital good (PIPP), with both effects being highly significant.

Also according to the TSLS equation, the private capital stock to output ratio (which reflects the effect of the productivity of capital and or the accelerator effect) is found to be highly significant and has a high positive coefficient at about 0.25. The wealth effect as measured by the ratio of base money to GDP is also highly significant, with an estimated coefficient of 1.80. Such a large effect on the investment rate due to the $\frac{H}{GDP}$ ratio will ensure a strong link between goods and asset markets in the model. We dropped from the estimation the price of the imported investment good relative to its domestic counterpart because it was found to be highly insignificant in preliminary runs. The variables D7375 and D84 are introduced in order to take account of periods judged to represent unusually higher than normal investment expenditure relative to GDP.

Finally, it is clear that there is evidence of significant liquidity-constraint effects on the investment ratio as measured by the profits to GDP (PRO/GDP) ratio. Its effect is both statistically significant and numerically appreciable with a magnitude of 0.42. This evidence on the role of liquidity constraints is consistent with the fact that interest rate controls have been a dominant feature in Zimbabwe, and where the controls have been partially relaxed only throughout the last years. Even under complete domestic financial liberalization one should expect that borrowing constraints would affect private capital formation over and above the influence of totally liberalized interest rates.

6. National-Good Private Fixed Investment

The marginal response of national-good investment to aggregate private investment is 0.33, while the estimated coefficient of the price of imported

relative to national investment goods is relatively high at 0.12. However, the latter variable is only slightly significant.

7. Export Demand

The demand for Zimbabwe's exports by foreigners is estimated as a ratio to GDP depending on the foreign price of exports relative to an aggregate foreign price index (the US wholesale price index) and foreign income proxied by OECD GDP level relative to domestic GDP. Using the current price ratio presents a simultaneity problem that could not be successfully resolved by using TSLS. Thus we estimated the equation using a lagged relative price ratio. The results in equation 7 show price and scale variables consistent with prior expectations. While the price effect is significant, the scale effect is not, however. On the other hand, we don't consider our estimate of the price effect to be entirely successful given its low magnitude, which does not seem to be consistent with the stylized fact of Zimbabwean exports facing more or less given international prices. The equation also included a time trend to account for a secular decline in exports during 1966-80. Despite the lack of significance of the scale effect, we nonetheless think that this equation will be superior for simulation purposes as compared to the one that does not account for foreign economic activity.

8. Portfolio Demands for Base Money and Public Debt

Equations 8 and 8.1-8.3 of annex A present estimation results for the demand for base money (H) relative to either public debt (B) or bonds plus base money (H+B), as linear functions of the nominal interest rate, real income, and a time trend variable. All of the equations have very good fits. Only equations 8 and 8.3, however, have reasonably acceptable DW statistics. Also in terms of parameters estimates and significance, these two equations perform better.

According to equation 8, the log of the H/B ratio depends negatively on the interest rate IB with a high and significant coefficient at -3.03. The real income effect is also high with an elasticity equal to 1.29 and a marginal

significance level equal to 6.8%. The effect due to the time trend is also significant and reflects the observed accelerated rise in H/B during the 1965-76 period in Zimbabwe.

The results of the estimation of log $\frac{H}{H+B}$ reported in equation 8.3 are similar and in fact either of equations 8 or 8.3 could be chosen as the final equation for simulation purposes.

9. Portfolio Demands for Money and Quasi Money

According to equation (2.2.6) above, the demand for M1 relative to broad money (M1+QM) is determined by the nominal return on quasi-monetary assets (IQM). In equation 9 of annex A we estimated the logarithm of this ratio as a linear function of IQM, the log of real income, and a time trend for the period 1965-76, which witnessed a decline in the ratio of M1 to broad money. In equation 9.1 we included a dummy variable for the 1965-1987 period to distinguish it from the last sample year (1988), which witnessed an unusually high M1 to QM ratio. This effect, however, was not found to be significant and was dropped from subsequent specifications. The result of equation 9 is satisfactory with the coefficient of IQM consistent with prior expectation at -4.45, with a very high marginal significance level. The effect due to real income is 0.34 and is also highly significant with a 1.3% marginal significance level. The time trend is consistent with the above interpretation and is also highly significant.

Other relatively less successful specifications for the demand for M1 relative to quasi money (QM), in both absolute and logarithmic levels, are reported in equations 9.2-9.4.

5. CONCLUSIONS

Despite running huge fiscal deficits over the last decade averaging more than 12% of GDP, the economy of Zimbabwe remains fairly stable. Inflation currently at an annual rate of about 13% is still low and real interest rates are negative or close to zero even after the partial financial liberalization and interest decontrol. The highly effective ensemble of exchange control and import rationing provided Zimbabwe with one of the highest private saving rates by comparable LDCs standards (20% of GDP), while helping squeeze private sector investment expenditure to levels less than 9% of GDP over the last five years. The relatively developed -albeit managed- financial markets and the perceived stability of public debt management in Zimbabwe served to recycle this saving to finance public deficits.

Therefore the non-inflationary finance of the deficit in Zimbabwe was made possible by the almost total reliance on debt finance (especially domestic debt in recent years) at low interest rates. This allowed the authorities to pursue a rather cautious monetary policy throughout the period and a more prudent external debt policy after 1982, when domestic debt became the main source for financing the deficit, without being forced to cut the deficit substantially. The cost of this policy, however, has been to sacrifice the role of private investment in contributing to (if not being the engine of) growth, which limited severely the post-independence economic recovery. Furthermore this policy of high debt-financed deficits is hardly sustainable in the future, and is likely to collapse if the economy is subjected to adverse external shocks or if corrective real depreciation measures were effected in response to changing fundamentals (see Schmidt-Hebbel, 1990, and Morande and Schmidt-Hebbel 1991).

In order to restore economic growth and consolidate the gains achieved in the areas of human capital development, improvement of income distribution and elimination of poverty, economic reform is needed in Zimbabwe. The broad elements of this reform must include fiscal deficit reduction and public enterprise reform, product and factor market deregulation, trade liberalization, and further deepening of financial liberalization. The main objectives of this

reform package are to increase private sector expenditure, especially on fixed investment, and to increase the competitiveness of the economy in order to reclaim growth and reduce the stringent unemployment problem, currently standing at a 26% rate.

In this paper we developed a behavioral model for the Zimbabwean economy that accounts for the above described stylized facts. Equilibrium in the goods market determines jointly real output and the GDP deflator (and hence the real exchange rate for a nominal exchange rate fixed by the central bank) and asset market equilibria, on the other hand, determines nominal interest rates (and hence the real interest rate for given inflation expectations).

The econometric estimation of the model broadly corroborated the model structure and provided evidence consistent with the stylized facts of the Zimbabwean economy. Our estimations show that in Zimbabwe's relatively closed economy, the real wage became by far the most important determinant of short-run output compared to the real exchange rate. The results for the derived demand for intermediate imports suggest labor to be a complement of the former and with the effect of the real wage equivalent in magnitude to that of the own effect of the relative price of intermediate goods imports.

On the demand side, aggregate private consumption is found to be influenced by the permanent to current income ratio and no significant effects could be established for inflation, real interest rates, and liquidity constraint variables (consumer credit and base money). The most resounding result, however, is the strong and highly significant positive effect of public saving, due probably mostly to direct crowding out of private consumption by public dissaving and not Ricardian anticipations of future taxes.

For private investment demand many factors are found to be at work, including the real interest cost net of depreciation, the relative price of investment, the private capital stock, and liquidity constraints proxied by the monetary base and firm profits. The latter effect of liquidity constraints, which is consistent with the regime of interest rate controls that dominated the past decade, will continue to assume some significance even after interest rates

are fully liberalized.

Finally the asset demand estimations support a conventional portfolio structure. The nominal interest rate on public debt is shown to have a strong and significant negative effect on the demand for base money relative to public bonds while the transaction effect on portfolio composition is positive. Analogously the relative demand for narrow money with respect to quasi money is strongly and negatively influenced by the interest rate on deposits, while income has a positive effect on the M1 to quasi money ratio.

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APPENDIX

ESTIMATON RESULTS FOR ZIMBABWE

ESTIMATION RESULTS FOR ZIMBABWE

I. LIST OF VARIABLES

II. EQUATIONS

Equation 1. Intermediate Imports Relative to Potential Output (OLS)
Equation 2. Output Relative to Potential Output w/o Rp (NLTSLS)
Equation 2.1 Output Relative to Potential Output (NLLS)
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Equation 9.1 Demand for Money and Broad Money, $\log(\frac{M1}{M1+QM})$ (ARC)
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III. TABLES

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Table (A2) Stability for the Regressions

IV. FIGURES

Figure (A.1) - (...) In and Out-of-Sample Forecasts

LIST OF VARIABLES

B1NOM	Nominal gross domestic public debt
C	Constant
CCNOM	National consumer credit
CP	Real private consumption
CPN	National component of real private consumption
DPCPPCP	Consumption inflation
DY	Real disposable income
E	Nominal exchange rate
FIL	Real total fixed investment
FIP	Real private fixed investment
FIPN	National component of real private fixed investment
FSNOM	Nominal foreign savings
GSNOM	Nominal government savings
HNOM	Nominal money base
IB	Nominal interest on public debt
IQM	Nominal interest on quasi money
M1NOM	Nominal money
M2NOM	Nominal money and quasi money
MINT	Imports of intermediate goods
P	Price index for GDP (deflator)
PC	Price index for total consumption
PCP	Price index for private consumption
PCPM	Price index for imported component of private consumption
PCPN	Price index for national component of private consumption
PDY	Permanent real disposable income
PF	Price index for GDP of OECD countries
PIP	Price index for private fixed investment
PIPM	Price index for imported component of private investment
PIPN	Price index for national component of private investment
PMINT	Price index for imports of intermediate goods
PRO	Aggregate profits
PSG	Permanent real public savings
PX	Price index for exports of goods and nonfactor services
QM	Quasi money
REALIBPF	Real interest rate on public bonds, perfect foresight
REALIBSE	Real interest rate on public bonds, static expectations
RILSE	Real interest rate on loans, static expectations
S	Real savings
UNITLC	Unit Labor Cost
X	Real exports of goods and nonfactor services
Y	Real Gross Domestic Product
YF	Real GDP of OECD countries
YP	Potential Gross Domestic Product

LIST OF VARIABLES

(Cont.)

CCNOMDY	= CCNOM/DY
CPDY	= CP/DY
CPNCP	= CPN/CP
FIPNFIP	= FIPN/FIP
FSNOMDY	= FSNOM/DY
GSNOMDY	= GSNOM/DY
HB	= HNOM/B1NOM
HHB	= HNOM/(HNOM+B1NOM)
HNOMDY	= HNOM/DY
HY	= HNOM/(P*Y)
IYFY	= YFY (1980=100)
LHB	= LN(HB)
LHHB	= LN(HHB)
LM1LM2	= LN(M1M2)
LM1QM	= LN(M1/QM)
LY	= LN(Y)
M1M2	= M1NOM/M2NOM
M1QM	= M1NOM/QM
MINTYP	= MINT/YP
PIPMPIPN	= PIPM/PIPN
PCPMPCPN	= PCPM/PCPN
PDYDYPF	= PDY/DY with perfect foresight of inflation
PDYDYSE	= PDY/DY with static expectations
PIPP	= PIP/P
PMINTP	= PMINT/P
PROY	= PRO/Y
PSGPFDY	= PSG/DY with perfect foresight of inflation
PSGSEDY	= PSG/DY with static expectations
PXFPF	= [(PX/E)/PF]
XY	= X/Y
YFY	= YF/Y
YK1	= Y/K(-1)
YYP	= Y/YP

TABLE A1.1a: AUTOCORRELATIONS - INTERMEDIATE IMPORT DEMAND

Lags	MINTYP	YYP	UNITLC	PMINTP	Residual
1	0.883	0.874	0.795	0.791	-0.298
2	-0.339	-0.534	0.144	-0.051	0.020
3	-0.069	-0.161	-0.051	0.158	0.193
4	-0.041	0.014	-0.221	-0.213	-0.067
5	-0.127	0.087	0.050	0.037	-0.058

TABLE A1.1b: AUTOCORRELATIONS - INTERMEDIATE IMPORT DEMAND

Lags	delta MINTYP	delta YYP	delta UNITLC	delta PMINTP	delta Residual
1	0.288	0.422	-0.267	0.068	-0.633
2	-0.130	0.018	-0.098	-0.312	-0.466
3	0.011	-0.324	-0.030	-0.033	-0.109
4	-0.260	-0.194	-0.152	-0.059	-0.082
5	-0.109	0.055	0.286	0.199	0.355

TABLE A1.2a: AUTOCORRELATIONS - OUTPUT SUPPLY

Lags	LNYYP	LNADJPW	LNPPMINT	Residual
1	0.854	0.786	0.812	-0.146
2	-0.468	0.140	-0.081	-0.029
3	-0.286	-0.076	0.104	0.002

TABLE A1.2b: AUTOCORRELATIONS - OUTPUT SUPPLY

Lags	delta LNYYP	delta LNADJPW	delta LNPPMINT	delta Residual
1	0.490	-0.281	0.037	-0.541
2	-0.158	-0.090	-0.301	-0.301
3	-0.304	-0.072	-0.005	0.004

TABLE A1.3a: AUTOCORRELATIONS – AGGREGATE PRIVATE CONSUMPTION

Lags	CPDY	PDYDYSE	PSGSEDY	Residual
1	0.222	0.760	0.363	-0.007
2	0.097	-0.028	0.262	0.220
3	0.125	-0.122	-0.152	0.187
4	-0.086	-0.055	-0.226	-0.249
5	0.019	-0.008	0.152	-0.323
6	-0.198	-0.426	-0.550	-0.155
7	0.326	0.163	0.003	-0.074
8	-0.174	-0.034	-0.136	-0.008

TABLE A1.3b: AUTOCORRELATIONS – AGGREGATE PRIVATE CONSUMPTION

Lags	delta CPDY	delta PDYDYSE	delta PSGSEDY	delta Residual
1	-0.449	-0.081	-0.531	-0.554
2	-0.308	-0.042	-0.062	-0.318
3	-0.024	-0.096	0.047	0.086
4	-0.125	-0.100	-0.266	0.067
5	0.155	0.283	0.349	-0.085
6	-0.334	-0.397	-0.287	-0.158
7	0.226	-0.085	-0.069	-0.123
8	0.058	0.132	-0.119	0.051

TABLE A1.4a: AUTOCORRELATIONS – NATIONAL GOOD PRIVATE CONSUMPTION

Lags	CPNCP	PCPMPCPN	Residual
1	0.760	0.851	0.105
2	-0.271	-0.034	-0.172
3	0.148	-0.113	-0.003
4	-0.284	-0.101	-0.370
5	0.345	-0.082	-0.156
6	-0.027	-0.168	0.209
7	-0.161	0.151	-0.050
8	0.027	0.121	-0.073

TABLE A1.4b: AUTOCORRELATIONS – NATIONAL GOOD PRIVATE CONSUMPTION

Lags	delta CPNCP	delta PCPMPCPN	delta Residual
1	0.148	0.047	-0.137
2	-0.287	-0.153	-0.327
3	0.163	0.066	0.189
4	-0.456	-0.023	-0.311
5	-0.027	0.120	-0.304
6	0.049	-0.119	0.155
7	-0.086	-0.103	0.058
8	-0.159	-0.033	-0.139

TABLE A1.5a: AUTOCORRELATIONS - AGGREGATE PRIVATE FIXED INVESTMENT

Lags	FIPY	RIL	YK	PROY	HY	PIPP	Residual
1	0.774	0.767	0.893	0.757	0.800	0.765	-0.234
2	-0.278	0.422	-0.561	0.109	-0.089	0.015	-0.344
3	-0.004	-0.132	-0.018	-0.276	-0.065	-0.033	-0.078
4	-0.160	0.123	-0.267	-0.069	-0.101	-0.158	0.010

TABLE A1.5b: AUTOCORRELATIONS - AGGREGATE PRIVATE FIXED INVESTMENT

Lags	delta FIPY	delta RIL	delta YK	delta PROY	delta HY	delta PIPP	delta Residual
1	0.166	0.353	0.480	-0.318	0.133	0.152	-0.405
2	-0.199	-0.107	-0.083	0.087	-0.247	-0.308	-0.382
3	-0.053	-0.241	-0.142	-0.192	0.006	0.184	-0.241
4	-0.288	0.003	-0.120	-0.478	0.241	0.108	0.107

TABLE A1.6a: AUTOCORRELATIONS - NATIONAL GOOD PRIVATE INVESTMENT

Lags	FIPNFIPM	PIPMPIPN	Residual
1	0.815	0.823	0.168
2	-0.328	-0.205	0.119
3	-0.121	-0.048	0.110
4	-0.065	0.117	0.005

TABLE A1.6b: AUTOCORRELATIONS - NATIONAL GOOD PRIVATE INVESTMENT

Lags	delta FIPNFIPM	delta PIPMPIPN	delta Residual
1	0.186	-0.120	-0.537
2	-0.069	-0.357	-0.297
3	-0.051	0.041	-0.084

TABLE A1.7a: AUTOCORRELATIONS – EXPORT DEMAND

Lags	XY	PXFPF	IYFY	Residual
1	0.767	0.614	0.720	0.175
2	-0.184	-0.390	-0.615	-0.274
3	0.122	0.218	-0.066	0.199
4	-0.076	-0.068	-0.218	-0.103
5	0.028	-0.116	-0.016	-0.047
6	-0.064	0.303	-0.400	-0.029

TABLE A1.7b: AUTOCORRELATIONS – EXPORT DEMAND

Lags	delta XY	delta PXFPF	delta IYFY	delta Residual
1	0.185	0.190	0.389	-0.172
2	-0.397	-0.534	-0.256	-0.425
3	-0.055	0.017	-0.218	0.015
4	-0.180	-0.206	-0.210	-0.120
5	-0.259	-0.181	0.025	0.007
6	0.036	-0.027	-0.240	0.106

TABLE A1.8a: AUTOCORRELATIONS – BASE MONEY / PUBLIC DEBT DEMAND

Lags	LHB	IB	LY	Residual
1	0.870	0.809	0.848	0.142
2	-0.101	-0.232	-0.118	-0.078
3	-0.131	-0.077	-0.098	-0.240
4	-0.095	-0.002	-0.103	-0.335
5	-0.068	-0.037	0.063	-0.122
6	-0.067	-0.126	-0.097	-0.339
7	-0.046	-0.065	-0.001	-0.098
8	-0.023	0.132	-0.007	-0.137
9	0.009	0.055	0.061	-0.038

TABLE A1.8b: AUTOCORRELATIONS – BASE MONEY / PUBLIC DEBT DEMAND

Lags	delta LHB	delta IB	delta LY	delta Residual
1	0.651	0.406	0.318	-0.391
2	-0.358	-0.415	0.025	-0.129
3	0.229	0.648	-0.292	-0.139
4	0.018	-0.249	-0.159	-0.266
5	-0.039	-0.020	0.009	-0.058
6	-0.103	-0.148	-0.289	-0.303
7	0.098	-0.257	-0.061	-0.209
8	0.135	0.028	-0.081	-0.240
9	-0.051	0.081	0.071	0.051

TABLE A1.9a: AUTOCORRELATIONS – NARROW MONEY / BROAD MONEY DEMAND

Lags	LM1M2	IQM	LY	Residual
1	0.820	0.851	0.848	0.108
2	0.045	-0.087	-0.118	-0.164
3	0.069	-0.061	-0.098	0.012

TABLE A1.9a: AUTOCORRELATIONS – NARROW MONEY / BROAD MONEY DEMAND

Lags	delta LM1M2	delta IQM	delta LY	delta Residual
1	-0.406	-0.029	0.318	-0.317
2	0.018	-0.070	0.025	-0.324
3	-0.320	-0.077	-0.292	-0.083

TABLE (A.2)
STABILITY OF THE REGRESSIONS

	CHI SQUARED (2 forecasts)	CHOW (2 forecasts)
INTERMEDIATE IMPORT DEMAND	4.75 (27.6)	2.78 (3.59)
OUTPUT SUPPLY	0.47 (26.3)	0.43 (3.63)
AGGREGATE PRIVATE CONSUMPTION 1/	2.41 (28.9)	1.18 (4.41)
NATIONAL GOOD PRIVATE CONSUMPTION	1.10 (32.7)	1.00 (3.47)
AGGREGATE PRIVATE FIXED INVESTMENT	1.35 (19.7)	0.64 (3.98)
NATIONAL GOOD PRIVATE INVESTMENT	1.16 (32.7)	1.01 (3.47)
EXPORT DEMAND	1.16 (27.6)	0.58 (3.59)
BASE MONEY / PUBLIC DEBT DEMAND	6.75 (30.1)	2.80 (3.52)
NARROW MONEY / BROAD MONEY DEMAN	8.12 (30.1)	5.77 (3.52)

Notes: 1/ 1 forecast
5% Significance level in parentheses

1 INTERMEDIATE IMPORT DEMAND
Dependent Variable: MINTYP
Sample Range: 1966-1988
Ordinary Least Squares

Variable	Coefficient	T-Statistic
C	0.13	1.48
YYP	0.37	4.97
UNITLC	-0.16	-2.37
PMINTP	-0.14	-3.03
D7075	-0.02	-1.22

R-Squared:	0.91
Adj. R-Squared:	0.89
Durbin Watson:	1.71

2 OUTPUT SUPPLY
Dependent Variable: LNYYP
Sample Range: 1967-1988
Nonlinear Two-Stage Least Squares

Variable	Coefficient	T-Statistic
GAMMA	-0.10	-2.73
LAMBDA	0.69	3.93
ALPHA	0.92	5.98
DELTA1	-0.13	-3.86
DELTA2	-0.30	-6.61

R-Squared:	0.94
Adj. R-Squared:	0.92
Durbin Watson:	2.08

2.1 OUTPUT SUPPLY
Dependent Variable: LNYYP
Sample Range: 1967-1988
Nonlinear Least Squares

Variable	Coefficient	T-Statistic
GAMMA	-0.11	-4.16
LAMBDA	0.66	5.78
ALPHA	0.93	8.58
BETA	0.26	1.29
DELTA1	-0 13	-5.02
DELTA2	-0.30	-9.42

R-Squared:	0.95
Adj. R-Squared:	0.93
Durbin Watson:	2.25

2.2 OUTPUT SUPPLY
Dependent Variable: LNYYP
Sample Range: 1967-1988
Nonlinear Least Squares

Variable	Coefficient	T-Statistic
GAMMA	-0.12	-5.96
LAMBDA	0.57	6.20
ALPHA	0.82	7.86
DELTA1	-0.11	-5.29
DELTA2	-0.28	-10.02

R-Squared:	0.94
Adj. R-Squared:	0.93
Durbin Watson:	2.13

3 AGGREGATE PRIVATE CONSUMPTION
Dependent Variable: CPDY
Sample Range: 1965–1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	0.61	7.57
PDYDYSE	0.12	1.72
PSGSEDY	0.67	3.33
D74	-0.06	-2.02
D6586	-0.06	2.40
^RHO	0.72	5.03

R-Squared:	0.59
Adj. R-Squared:	0.50
Durbin Watson:	1.61

3.1 AGGREGATE PRIVATE CONSUMPTION
Dependent Variable: CPDY
Sample Range: 1965–1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	1.09	8.36
PDYDYSE	0.01	0.06
PSGSEDY	0.21	0.39
REALIBSE	-0.53	-0.78
DPCPPCP	-0.30	-0.39
CCNOMDY	-4.64	-1.35
FSNOMDY	0.08	0.36
PCPMPCPN	-0.15	-2.29
HNOMDY	-0.86	-1.14

R-Squared:	0.76
Adj. R-Squared:	0.62
Durbin Watson:	1.91

3.2 AGGREGATE PRIVATE CONSUMPTION
Dependent Variable: CPDY
Sample Range: 1966-1988
Ordinary Least Squares

Variable	Coefficient	T-Statistic
C	1.07	8.04
PCYCYPF	0.02	0.11
PCGPFDY	0.09	0.09
REALIBPF	-0.39	-0.61
DPCPPCP	-0.07	-0.11
CCNOMDY	-3.86	-0.68
GSHOMDY	0.06	0.27
PCPMPCPN	-0.16	-2.09
HNOMDY	-0.93	-0.77

R-Squared:	0.76
Adj. R-Squared:	0.62
Durbin Watson:	1.97

3.3 AGGREGATE PRIVATE CONSUMPTION
Dependent Variable: CPDY
Sample Range: 1966-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	0.66	10.61
PDYDYPF	0.09	1.71
PSGPFDY	0.05	0.20
D74	-0.03	-0.77
D6586	0.05	1.77
^RHO	0.13	0.65

R-Squared:	0.30
Adj. R-Squared:	0.16
Durbin Watson:	2.02

4 NATIONAL GOOD PRIVATE CONSUMPTION
Dependent Variable: CPNCP
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	0.85	46.96
PCPMPCPN	0.05	3.09
^RHO	0.46	2.57

R-Squared:	0.63
Adj. R-Squared:	0.62
Durbin Watson:	1.52

5 AGGREGATE PRIVATE FIXED INVESTMENT
Dependent Variable: FIPY
Sample Range: 1966-1988
Two Stage Least Squares

Variable	Coefficient	T-Statistic
C	-0.14	-3.00
RIL	-0.18	-2.60
YK1	0.25	4.57
PROY	0.42	3.97
HY	1.80	6.13
PIPP	-0.12	-6.12
D7375	0.02	4.27
D84	0.03	3.92

R-Squared:	0.98
Adj. R-Squared:	0.97
Durbin Watson:	2.32

6 NATIONAL GOOD PRIVATE FIXED INVESTMENT
Dependent Variable: FPINFIP
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	0.33	2.20
PIPMPIPN	0.12	1.55
^RHO	0.88	9.07

R-Squared:	0.75
Adj. R-Squared:	0.74
Durbin Watson:	1.51

7 EXPORT DEMAND
Dependent Variable: XY
Sample Range: 1967-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	0.39	3.30
PXFPF(-1)	-0.06	-1.83
IYFY	0.07	0.88
T6680	-0.01	-3.03
^RHO	0.66	4.16

R-Squared:	0.78
Adj. R-Squared:	0.76
Durbin Watson:	1.64

8 LOG OF BASE MONEY / PUBLIC DEBT DEMAND
Dependent Variable: LHB
Sample Range: 1966-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	-13.80	-5.54
IB	-3.03	-1.93
LY	1.29	3.81
T6576	0.14	7.47
^RHO	0.53	3.10

R-Squared:	0.99
Adj. R-Squared:	0.99
Durbin Watson:	1.58

8.1 BASE MONEY / PUBLIC DEBT DEMAND
Dependent Variable: HHB
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	-0.07	-2.67
IB	-0.27	-1.08
Y	0.00	2.84
T6576	0.01	2.48
^RHO	0.74	5.42

R-Squared:	0.97
Adj. R-Squared:	0.97
Durbin Watson:	1.23

8.2 BASE MONEY / PUBLIC DEBT DEMAND

Dependent Variable: HB
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	-0.09	-2.70
IB	-0.34	-1.00
Y	0.00	2.75
T6576	0.01	1.97
^RHO	0.75	5.50

R-Squared:	0.96
Adj. R-Squared:	0.96
Durbin Watson:	1.22

8.3 LOG OF BASE MONEY / PUBLIC DEBT DEMAND

Dependent Variable: LHHB
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	-12.89	-5.99
IB	-2.92	-2.15
Y	1.17	4.00
T6576	0.13	8.23
^RHO	0.52	2.99

R-Squared:	0.99
Adj. R-Squared:	0.99
Durbin Watson:	1.65

9 LOG OF NARROW MONEY / BROAD MONEY DEMAND
Dependent Variable: LM1LM2
Sample Range: 1965-1988
Ordinary Least Squares

Variable	Coefficient	T-Statistic
C	-2.80	-3.00
IQM	-4.45	-5.93
LY	0.34	2.72
T6576	-0.04	-6.38

R-Squared:	0.94
Adj. R-Squared:	0.93
Durbin Watson:	1.76

9.1 LOG OF NARROW MONEY / BROAD MONEY DEMAND
Dependent Variable: LM1M2
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	-3.16	-3.27
IQM	-4.57	-6.22
LY	0.39	3.00
T6576	0.04	-6.60
D6587	0.04	1.00
^RHO	0.05	-0.26

R-Squared:	0.94
Adj. R-Squared:	0.93
Durbin Watson:	1.95

9.2 LOG OF NARROW MONEY / QUASI MONEY DEMAND
Dependent Variable: LM1QM
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	-4.47	-1.88
IQM	-8.66	-4.81
LY	-0.73	2.30
T6576	-0.07	-5.91
D6587	0.05	0.54
^RHO	0.13	0.66

R-Squared:	0.95
Adj. R-Squared:	0.93
Durbin Watson:	1.85

9.3 NARROW MONEY / QUASI MONEY DEMAND

Dependent Variable: M1QM
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	1.95	6.07
IQM	-8.75	-2.61
Y	0.00	1.47
T6576	-0.12	-5.26
D6587	0.05	0.40
^RHO	0.36	1.87

R-Squared:	0.94
Adj. R-Squared:	0.92
Durbin Watson:	1.63

9.4 NARROW MONEY / BROAD MONEY DEMAND

Dependent Variable: M1M2
Sample Range: 1965-1988
Ordinary Least Squares (ARC)

Variable	Coefficient	T-Statistic
C	0.64	12.82
IQM	-2.43	-4.61
Y	0.00	2.36
T6576	-0.02	-6.10
D6587	0.02	0.90
^RHO	0.11	0.52

R-Squared:	0.95
Adj. R-Squared:	0.93
Durbin Watson:	1.91

Figure A.1

INTERMEDIATE IMPORT DEMAND

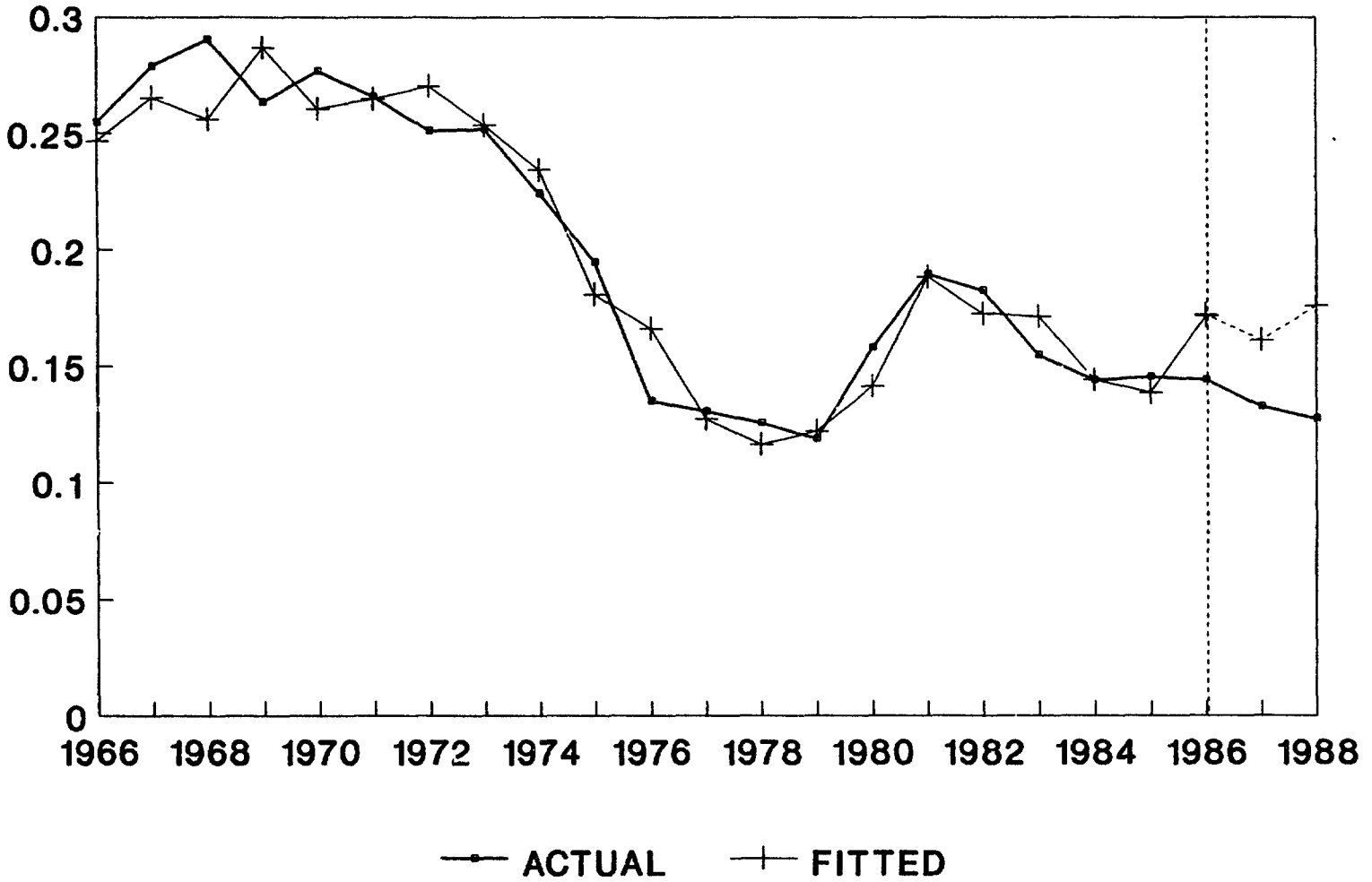


Figure A.2

OUTPUT SUPPLY

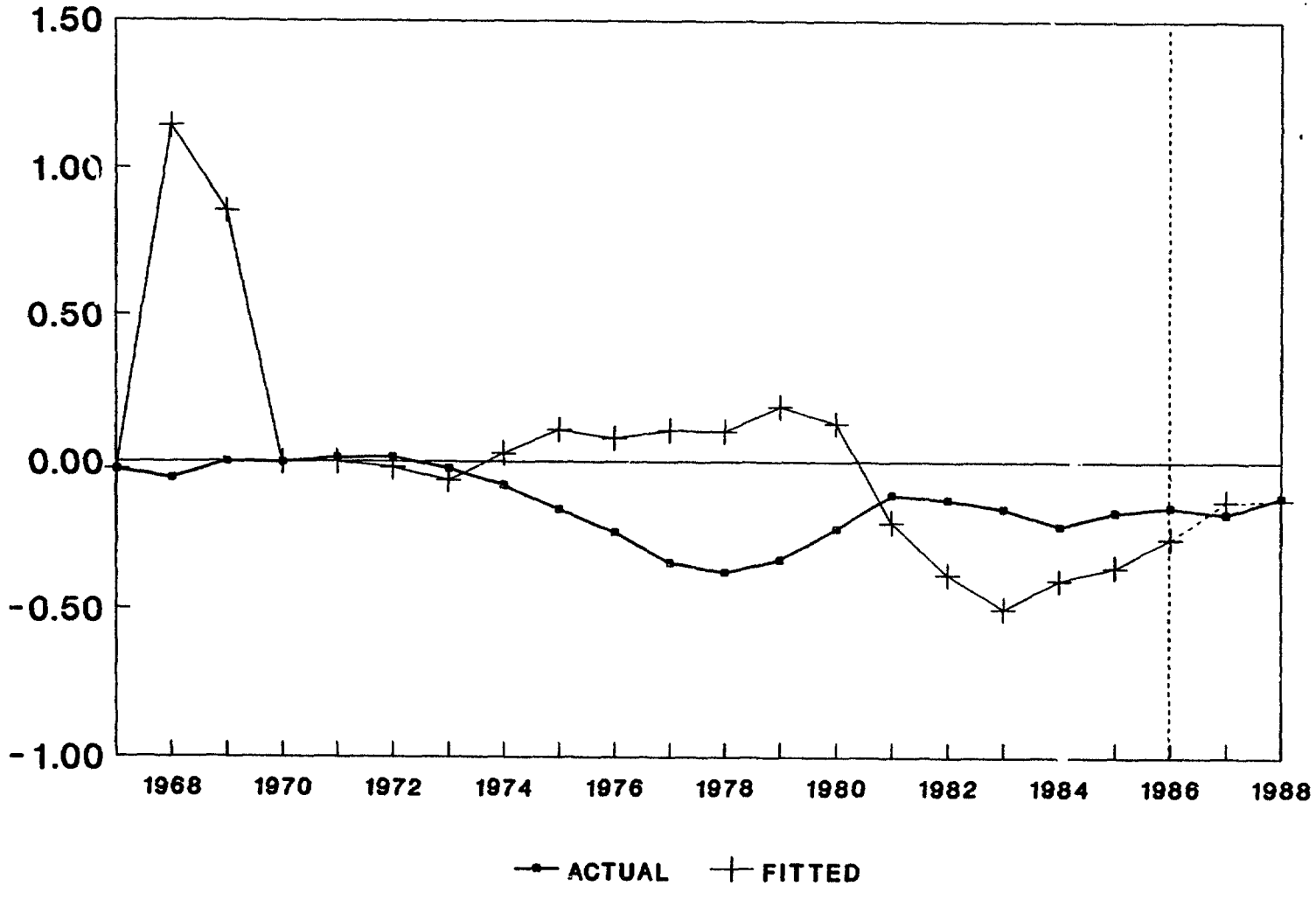


FIGURE A.3

AGGREGATE PRIVATE CONSUMPTION

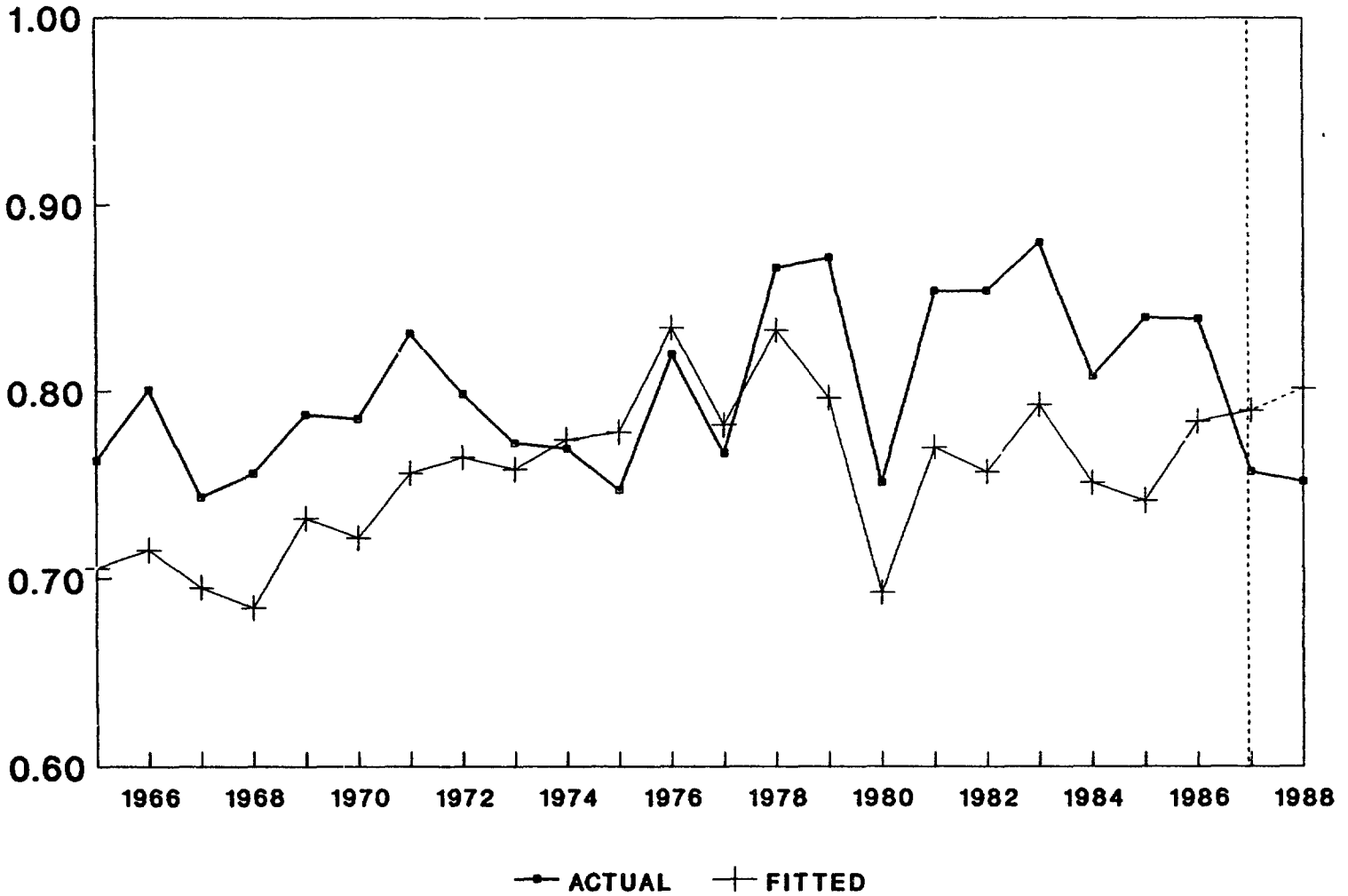


Figure A.4

PRIVATE NATIONAL GOOD CONSUMPTION

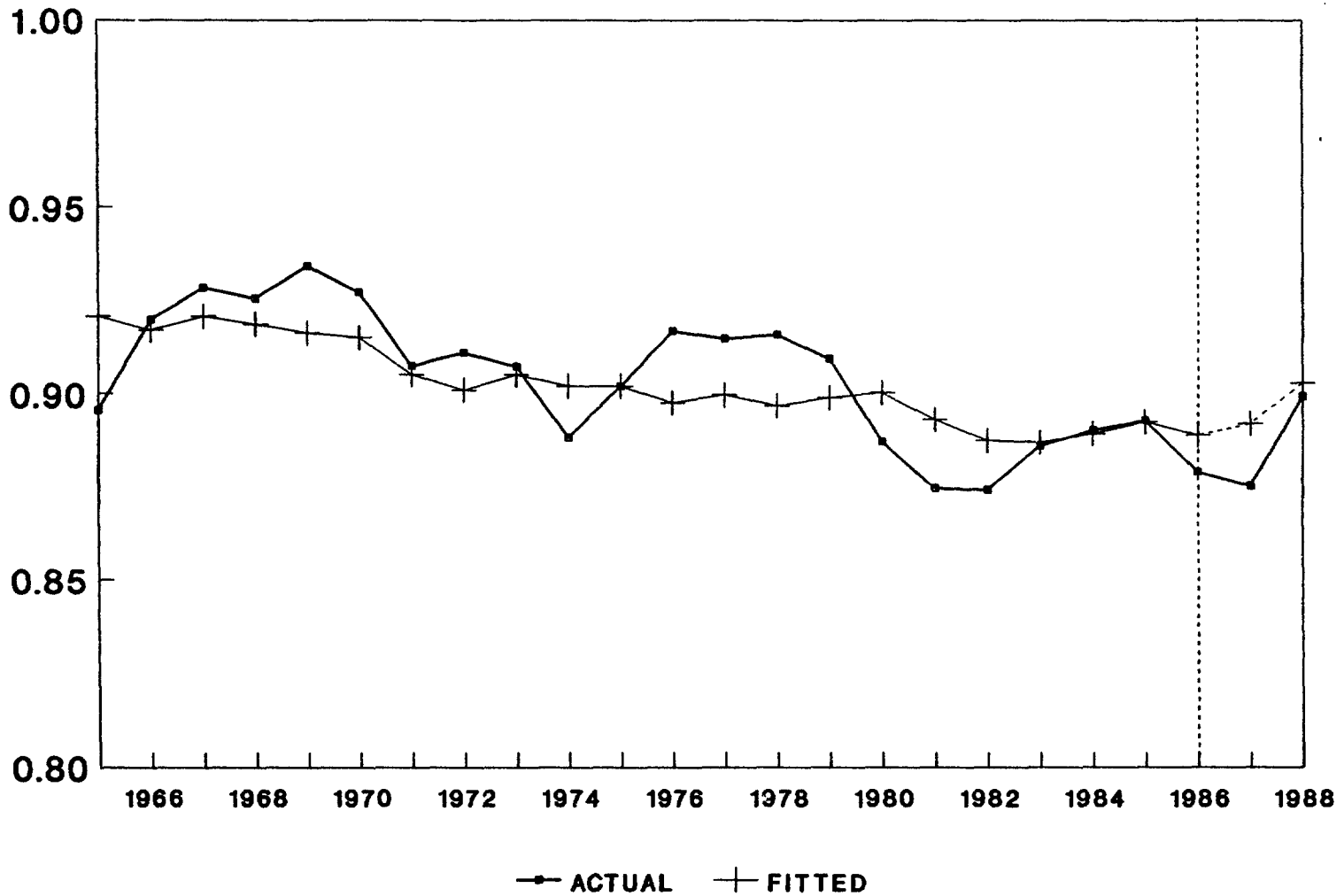


Figure A.5

AGGREGATE PRIVATE FIXED INVESTMENT

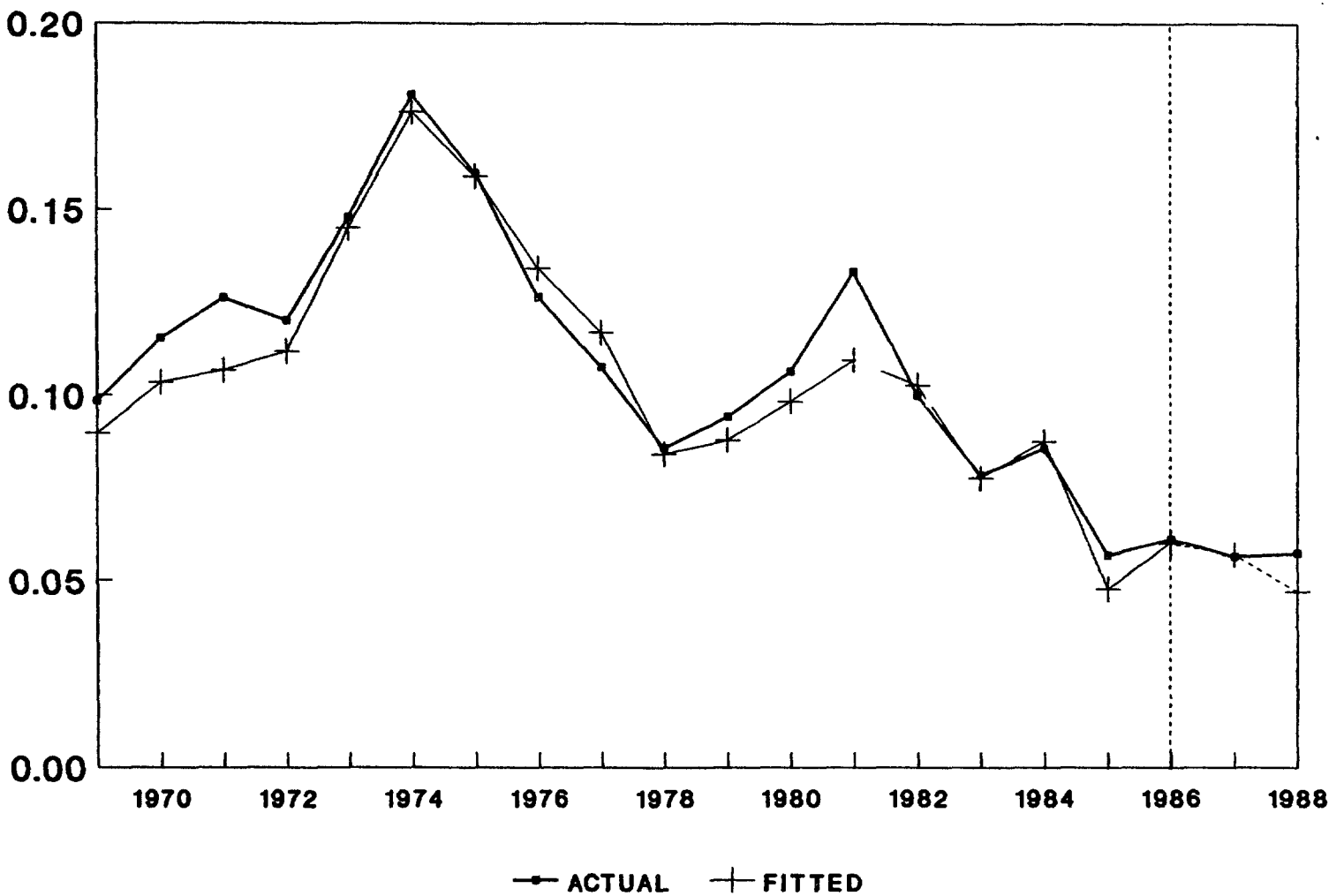


Figure A.6

NATIONAL GOOD PRIVATE FIXED INVESTMENT

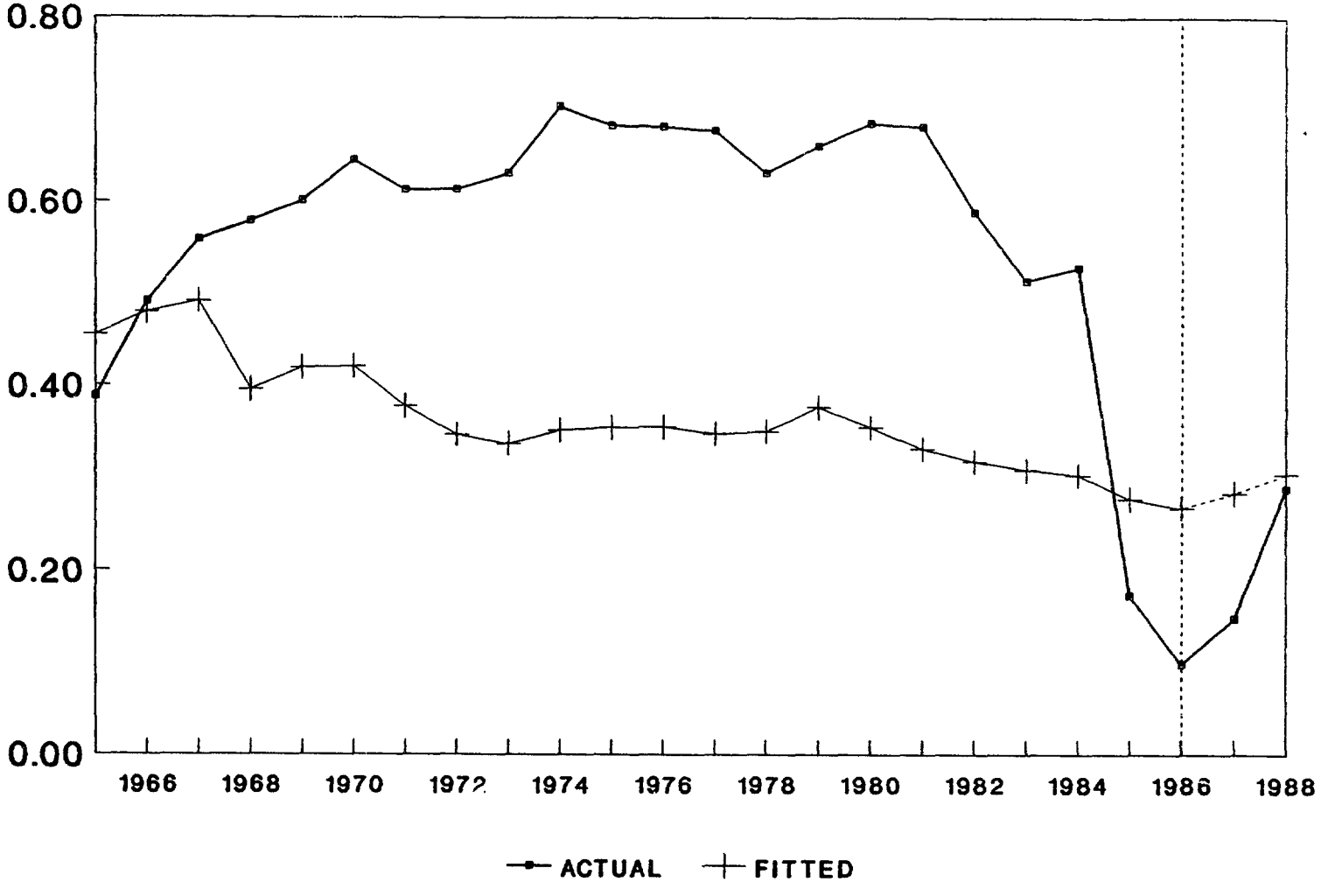


Figure A.7

EXPORT DEMAND

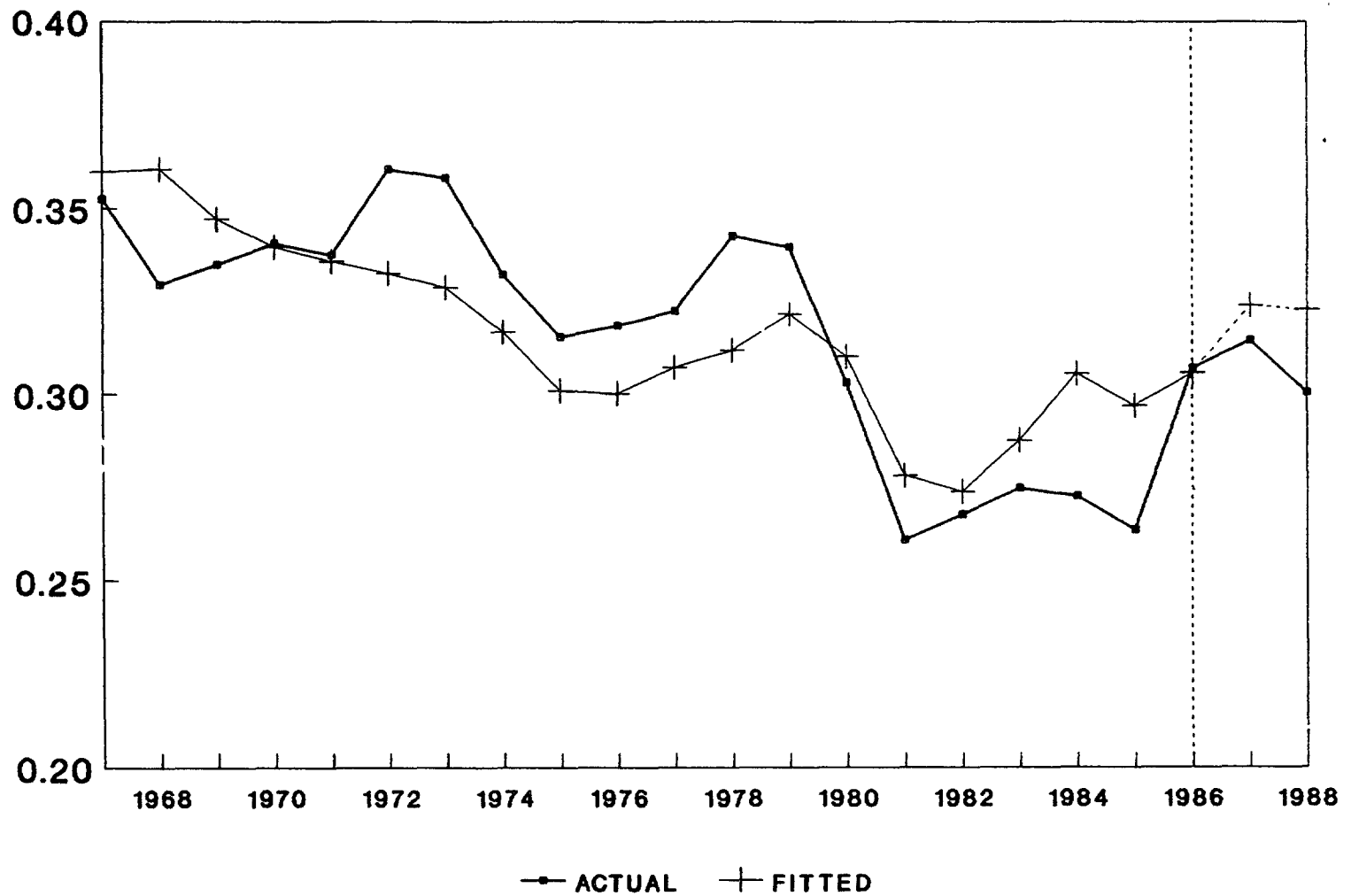


Figure A.8

BASE MONEY/PUBLIC DEBT DEMAND

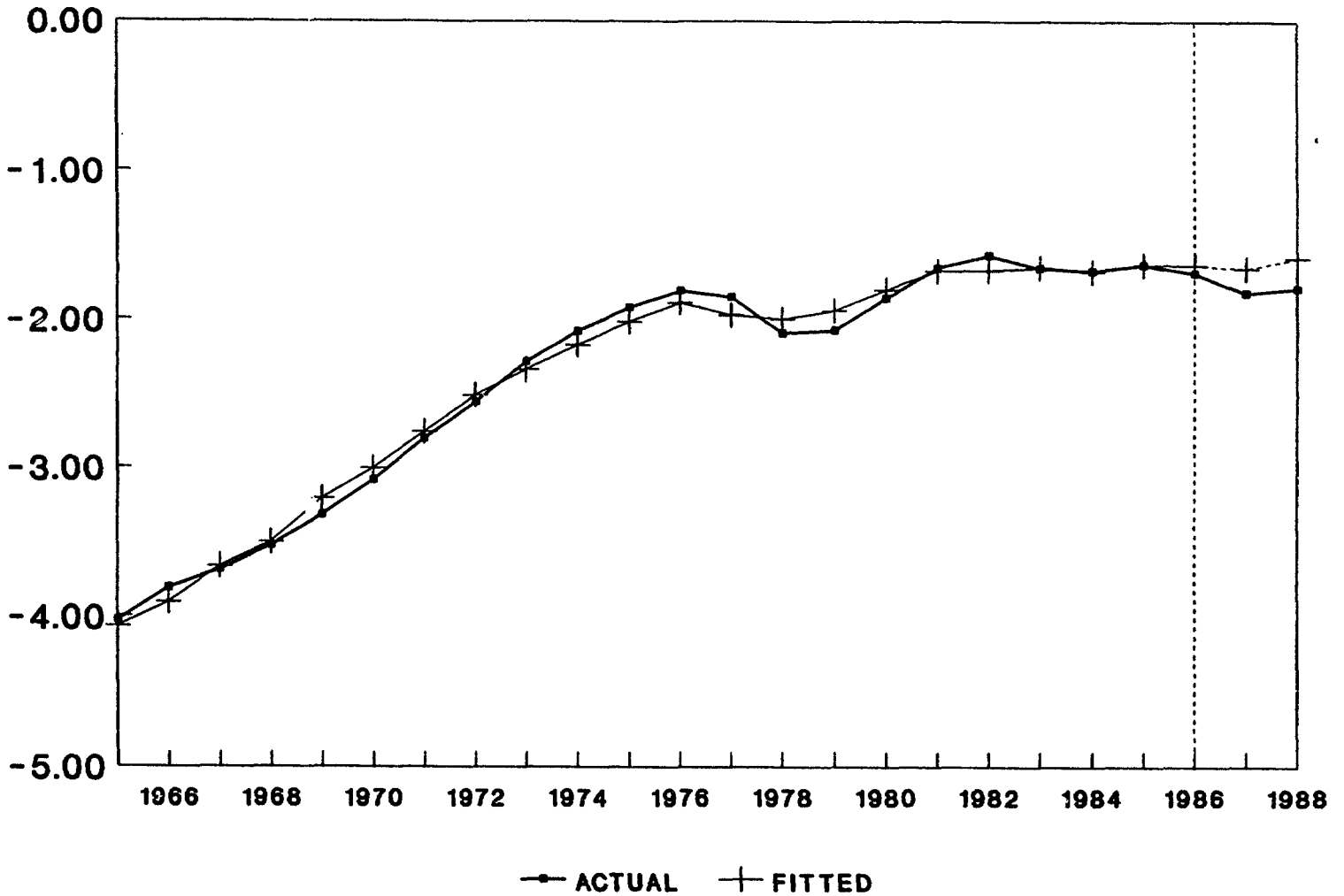
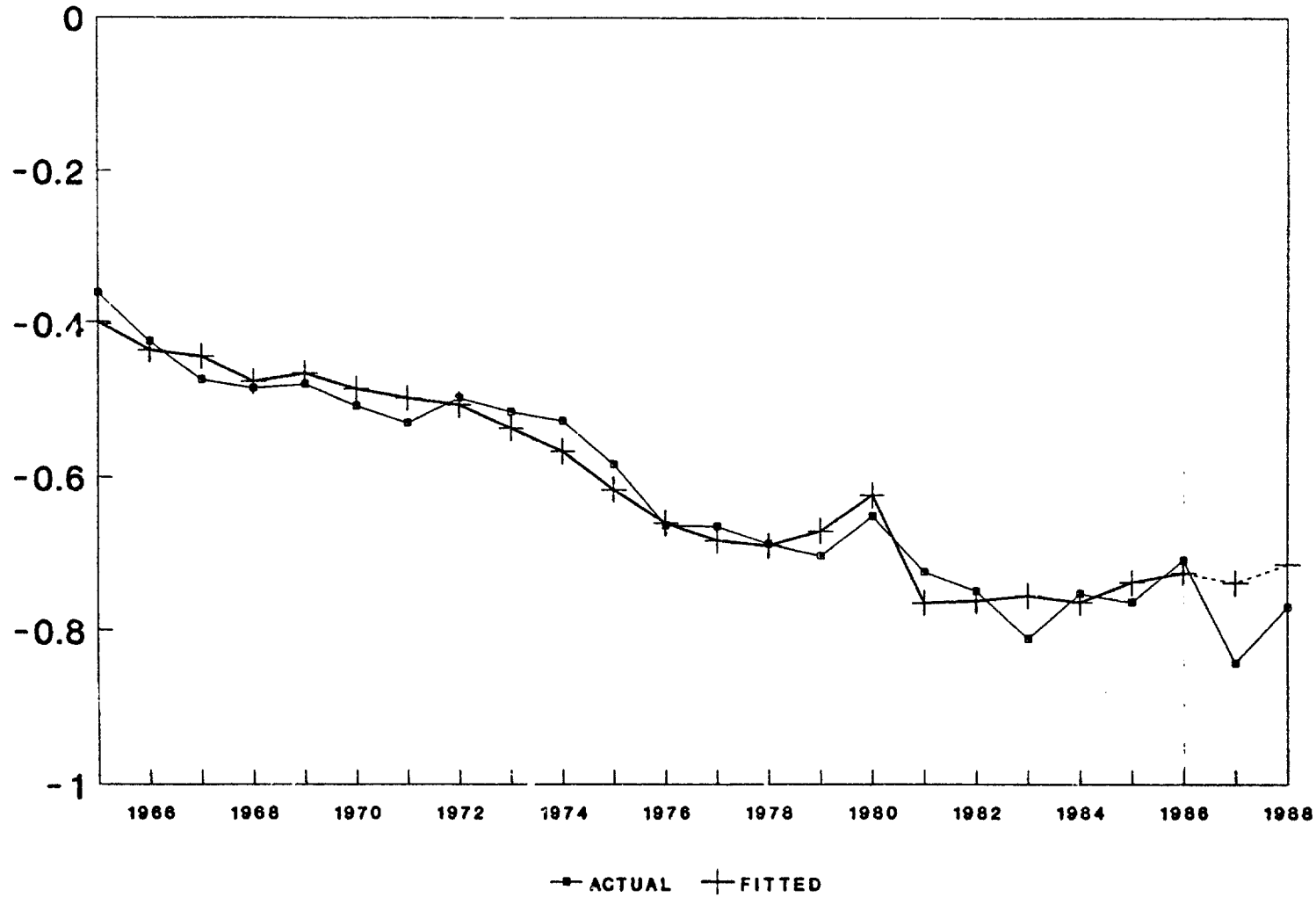


FIGURE A.9

NARROW MONEY/BROAD MONEY DEMAND



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